267

HANDBOOK

FOR THE

8-IN. R.M.L. HOWITZER OF 48 CWT.

MARK I.

1900.

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HANDBOOK

FOR THE

8-IN. R.M.L. HOWITZER OF 46 CWT.

MARK I.

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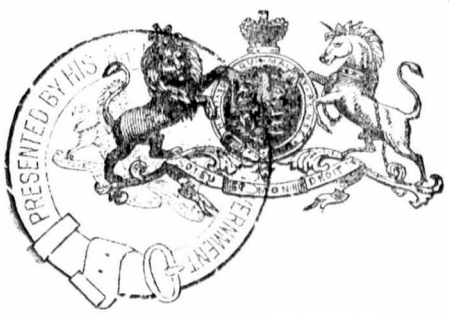
OF VICTORIA

FOR

MOVABLE ARMAMENT

OR

ARMAMENT OF WORKS.



1900.

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Note.—This Handbook is corrected up to September, 1900. Any alterations which may be suggested should be forwarded to the Chief Inspector, Woolwich.

8-INCH R.M.L. HOWITZER OF 46 Cwt. (MARK I.)

HOWITZER.

(*Plate* I.)

Material	exterior	.. ..	Wrought iron.
	tube	.. ..	Tough steel.
Length	nominal	.. ..	61·125 inches.
	total	.. ..	64 inches.
Weight, nominal		.. ..	46 cwt.
Preponderance		.. ..	2 cwt.
Bore ..	calibre	.. ..	8 inches.
	length	.. ..	48 inches.
	capacity, including unrifled portion	..	2114 cubic inches.
Chamber	diameter, smallest	.. .. ..	6·76 inches.
	length	.. ..	12·5 inches.
	capacity	.. ..	629·0 cubic inches.
Rifling..	system	.. ..	Woolwich.
	twist	.. ..	Uniform 1 in 16 calibres.
	length	.. ..	35·5 inches.
	grooves — number	.. .. ..	4.
	grooves — depth	.. .. ..	0·18 inch.
	grooves — width	.. .. ..	1·5 inch.
Means of rotation		.. ..	Copper gas-check with four projections.

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The howitzer is made of steel and wrought iron, and consists of a steel A tube forged solid at one end, over which are shrunk a wrought iron B tube, and a breech coil, the latter partially overlapping the B tube. The breech coil is provided with trunnions, and is prolonged to the rear for the reception of the cascable which is screwed into the breech coil, and engages with the rear end of the A tube.

The howitzer is radially vented with a copper vent, which is inclined to the rear at an angle 6° 3″ from the vertical, and enters the bore at 1·75 inches from the bottom of the chamber.

A clinometer plane is formed on the breech coil, immediately in front of the vent, for obtaining elevation, and planes for cross levelling are provided on the cascable, and on the front portion of the breech coil.

SIGHTING.

The howitzer is sighted on the right side with cross-bar sights.

The tangent sight drops into a socket, and is set vertically. The vertical bar is of steel, rectangular in section, and is graduated to 15 degrees. Adjustment is effected by means of the "clamp, tangent

sight B." The sight has a bronze head with clamping screws, and a steel horizontal cross-bar, which slides within the head to the extent of 1° to the right and 3° to the left, for deflection. The bar is provided with a sliding reversible leaf, having a notch for forward laying; this leaf is provided with a pointed sight for rough laying, and cross-wires for fine laying when used reversed. The bar is graduated from 0° to 8° right for the right side.

The foresight consists of a steel stem with horizontal half cross-bar (forged solid). The bar is fitted with a sliding reversible leaf, having a point for use with the notch of the tangent sight for forward laying, and a notch and eye-hole for rough and fine laying when used reversed.

The half cross-bar is graduated from 0° to 8°, to correspond with the cross-bar of the tangent sight.

The method of using these sights is explained in the drill (p. 35).

Instead of being sighted as above, some of these howitzers are provided with three sights, viz., a muzzle sight, foresight, and tangent sight. The tangent sight is graduated in degrees up to 16°, and is fitted with a leaf sliding 4° to the left and 1° to the right. The foresight is fixed on the end of the breech coil and is used for elevations not exceeding 3°. The muzzle sight is used for elevations over 3°. This system is, however, obsolete.

CARE AND PRESERVATION.

(*Extracts from "Regulations for Magazines and the Preservation of Artillery Matériel."*)

"473. A 'Memorandum of Examination' is issued with each . . howitzer. It contains a drawing showing the principal dimensions, with a short description of the construction and rifling, as well as the particulars of any slight original defects or tool marks which may have existed at the date of issue. In it are recorded in detail the number of rounds fired, and the date and result of any examination.

"474. This memorandum will remain in charge of the officer who has possession of the ordnance, and a certificate to the effect that it is in his possession and complete up to date, will be included in the Annual Return of Rifled Ordnance, Army Form G 872.

"475. At the conclusion of each day's firing an entry will be made in the memorandum by the officer in charge, giving a detail of the rounds fired (including blank charges), so that an accurate record of the firing may always be kept up.

"477. A statement of the results of the examination of any piece will be added to the memorandum by the inspecting officer or other examiner who performs the duty, and when the . . howitzer is returned into, or issued from, store, the memorandum will accompany the transfer vouchers.

"478. If at any time the memorandum be lost or damaged, a duplicate can be obtained from the Chief Inspector, Woolwich, by whom also inside sheets for continuation of the record of the number of rounds fired will be supplied on demand.

"479. All ordnance will, as far as possible, be examined after firing (either with powder or cordite) the numbers of rounds detailed below, and practice from such ordnance should cease until such

examination shall have been carried out. In cases, however, where the examination would happen within a series of rounds allowed for practice, and thus cause inconvenience, the howitzers will be examined before practice commences, irrespective of the number being completed.

"480. For the purpose of computing the number of rounds to be allowed between examinations two three-quarter, four half charges, or four blank charges are to be taken as equal to one full charge, any other reduced charge is to be taken as equal to the charge next above it. For recording the rounds on the memorandum of examination, three-quarter, half, or blank rounds should be shown as such. . .

"481. The following are the number of full rounds after which each nature of ordnance must be examined :—

Nature.	No. of full rounds with projectile.	Remarks.
R.M.L. 8-inch to 6-inch	100	—

"481A. Should any accident occur, such as the bursting of a shell in the bore, . . &c., immediate enquiry will be made into the circumstances, and the howitzer examined. If the commanding officer considers the damage to be of importance, he will send without delay a report of the circumstances through the same channel as his Annual Return, forwarding, if necessary for the illustration of his report, gutta-percha impressions of the damage done to the howitzer. An impression taken of a flaw or damage to a howitzer must not be destroyed until the howitzer is finally sentenced.

"482. Ordnance will be kept in good preservation, the exterior being painted . . . The bore will be cleaned and oiled or when not in frequent use lacquered with the following lacquer :—

		lbs.	ozs.
Lead,	black	24	8
	red	6	12
Lamp black		0	12
Oil, linseed, raw..		9 gallons.	

"The lacquer will be applied by means of a brush attached to a holder, and can be removed in a few minutes by brushing the bore with hot potash solution . .

"483. At the close of each day's firing with powder charges the bore will be washed and placed under metal, and as soon as dry will be oiled with a greasy sponge (a sponge cloth or piece of old linen tied over the piasaba brush). . . . .

"484. Ordnance, whether mounted or on skidding will be depressed at the muzzle to prevent rain or moisture lodging inside, and when mounted the muzzle will be stopped with a tampeon.

"486. All ordnance forming the armament of fortresses will be cleaned and painted biennially; but should it be found that those mounted on sea faces of works are in a bad state from exposure to the sea spray or those in casemates from damp and dripping, they will be cleaned and painted every year, and oftener if considered necessary, by the O.C.R.A. On this point, considered as a question of expense, a sound discretion will be exercised.

"487. The paint used will, at the discretion of the general officer commanding, be of such a colour as to render the ordnance as inconspicuous as possible.

"488. Before the working parties commence work, the ordnance will be dismounted and placed on skidding, in such a position as to admit of the exterior and interior of the piece being thoroughly well cleaned. In cases where, from the nature and position of the work, it may not be deemed advisable to dismount the pieces, they will be raised out of their trunnion holes to a sufficient height to admit . . of the howitzer being thoroughly scraped and cleaned, the sight sockets, when necessary, being plugged with tow and tallow.

"489. Ordnance will be scraped on the exterior (the scrapers or old swords supplied for the purpose being previously sharpened) until the old paint and all rust which may appear beneath it are entirely removed; the axis lines, ... and all marks will be completely cleaned out and rendered distinct, and the ordnance will afterwards be wiped over with a piece of old canvas or cloth . .

"490. The exterior of the piece . . will be painted with two coats of paint; the second coat will not be applied until the first coat has thoroughly set, and as in the process of mounting the ordnance the paint gets much rubbed, the second coat should be given, when possible, after the piece has been mounted.

"*Preservation of Sights.*

"494. When mounted in exposed positions, or in batteries accessible to the public, unguarded by sentries, all the sights . . . . will be removed from the ordnance and kept in store, the sight recesses in the howitzers being filled with a plug of greased tow to keep out the rain and dirt. These plugs can be readily removed when it is required to fit the sights to the ordnance. Particular attention will be paid to the prevention of rust or grit accumulating in the sight recesses.

"496. The sights will be kept clean, free from grit, and oiled; the tangent sight-bars should on no account be polished; the sliding leaf as well as the collars of the foresights, should have free play.

"497. The exposed portions of the sights are bronzed if made of gunmetal, and blued if of steel, in order to preserve them from corrosion, and on no account will these parts be cleaned or burnished in such a manner as to remove the bronzing or blueing . . . .

"*Preservation of Fittings.*

"501. All fixing and preserving screws should be occasionally removed and oiled."

SPECIAL INSTRUCTIONS NOT IN "REGULATIONS FOR MAGAZINES, &c."

Elevating plates will be removed for transport, and the holes in the howitzer filled by preserving screws.

BED, HOWITZER, R.M.L. 8-INCH 46 CWT.*

(*Plate* II.)

The bed consists of two double plate wrought-iron brackets, connected by two transoms and a bottom plate. Each bracket is fitted with three metal rollers on steel axles, and a metal bushed square hole for the transporting axletree.

The elevating gear is fitted on the right bracket, and consists of a worm spindle with worm wheel and pinion, conveying motion from a hand wheel to an arc pivotted to the howitzer. The worm wheel is fitted with an adjustable friction cone which, by allowing a slight slip to the arc, reduces the shock on the gear when firing.

The gear is enclosed on the outside of the bracket by a metal cover.

The compressor gear consists of a bow or cramp fitted with a screw and lever at each end for adjustment and compression, by which three hanging plates on each side, projecting through openings in the bottom plate, are forced against the sides of a directing bar and compressor bars. The inner hanging plates have each a clip on the inward side, which catch against guide plates on the directing bar and prevent the bed rising during recoil. Two plates are fixed on the bottom plate of the bed, to prevent the compressor plates shifting. The compressor lever works on an arc on the left bracket, on which is a projection to hold the lever down when compression is on. The adjusting lever works on an arc on the right bracket, to which it can be keyed to the required adjustment.

The directing bar is built up of channel and plate iron. It is fitted with a hinged metal flap in front, which fits over a pivot on the ground platform, and it has an eye at the rear end, by which it can be hooked up to a transporting limber. A buffer stop of iron plates and india rubber pads, is fixed at each end. The front of the bar is slightly tapered, to allow the bed a slight recoil, before the compressor comes fully into action.

To Adjust and Work the Compressor.

Before practice run the bed back about 3 feet from the front stops, and adjust the compressor by means of the adjusting lever, until one man exerting his whole power on the compressor lever, can just force it past the projection on the arc; then secure the adjusting lever by the key, release the compressor lever, and run the howitzer up for firing.

Should the recoil be too violent, the adjusting lever must be moved one or more holes towards the front of the bed, and again secured by the key.

If the lever can be forced too far to the front to give the required adjustment, remove the nut and collar of the screw, take off the lever, and place it on the next position of the hexagon of the screw towards the rear, and secure it with the nut and collar. Should the recoil be less than required, a similar alteration must be made in the position of the lever, but in a reverse direction.

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* See footnote, page 8.

To Run Up.

Release the compressor lever by lifting it past the projection to the stop on the arc.

As the compressor is not self-acting, great care must be taken that the compressor lever is always pressed down past the projection before each round, as soon as the howitzer is run up.

For no other purpose than adjustment should the adjusting lever be moved; it is tightened when moved to the front, slackened by moving it towards the rear.

Elevation	45°
Height to axis of trunnions	2 ft. 6 ins.

	Weight.	Tonnage.
Bed	24·75 cwt.	1·187 tons.
Directing bar ..	8·25 „	0·216 „

PLATFORM, GROUND, R.M.L. HOWITZER BED.

The platform is made up by placing a wedge shaped centre piece between two siege* platforms and joining the whole together by an iron bar on the underside, an iron band at the rear, and a block of wood in front. A wrought-iron pivot plug is let into the centre of the front block. The siege* platform is of oak, and consists of two side baulks, dovetailed and bolted to a front and rear transom, with two centre baulks housed between them. The whole is strengthened by a strap of iron secured across the middle on the underside. Part of the platform is plated with iron to protect it from wear by the bed rollers; the transoms and side baulks are hooped to prevent splitting, and cast-iron racks are let into the rear transom to facilitate traversing by handspikes.

CARRIAGE, SIEGE, R.M.L. 8-INCH 46-CWT. HOWITZER.

(*Plate* III.)

This carriage, which is constructed to allow 30° elevation, was originally intended to admit of the howitzer being fired from the trail with the wheels off. For this purpose the trail brackets project to the front, and are fitted with a bottom plate extending from the rear transom to the breast of the trail. This plan has been superseded by the bed already described.

The carriage consists of two "double plate" brackets connected by two wrought iron transoms and a distance bolt, and strengthened by knee plates rivetted to the top of the rear transom.

The axletree bed is constructed on the box girder principle, by angle iron riveted on each side of the axletree; it is housed into the trail, flush with the underside of the brackets.

---

* The bed and platform were originally in the siege train, but are now used for permanent fortifications.

Elevating Gear.

The elevating gear consists of a cross shaft conveying motion from a hand wheel on the left side to two bevel wheels on the right side, which by means of a worm spindle actuate a worm wheel keyed on to a spindle pinion which gears into the elevating arc.

The arc is pivotted to the howitzer, and is kept in gear by two friction rollers. The worm wheel is fitted with a friction cone, which can be adjusted by means of two nuts, to allow sufficient slip to prevent damage when firing.

A stool bed of wood, strengthened by angle iron along each side, a large coin, a hand coin, and a small hand coin are fitted to and issued with each carriage for use in laying the howitzer, in case of any damage to the elevating gear; the stool bed also serves as the plank for the shifting roller (also supplied) when required to shift the howitzer from or to the travelling trunnion holes.

The wheels are 1st class, B, No. 6, 12-inch pipes, 5 feet diameter, 6-inch tire. The naves are of metal and the pipes of phosphor bronze.

The carriage is mounted on a double-decked platform, which is fitted with a central pivot, for the attachment of the hydraulic buffer.

The piston rod of the buffer is secured to the trail by a long bar, the front end of which is supported by a bracket, and the buffer cylinder is fitted with a trunnion ring, which is secured in bearings on the pivot plug.

For travelling, the buffer is raised and supported along the underside of the carriage by chains.

Hydraulic Buffer.

The buffer is of special pattern for use with siege carriages; the front and rear caps are of wrought iron, and screwed on the cylinder; a ring with trunnions is secured near the centre of the cylinder, and connected with the front cap by tie bars; the front cap is arranged for a leather packing ring, and also for cotton instead of the usual hemp packing. The piston rod is 2·75 inches diameter; and the front end is screwed to receive a link, by means of which it is shackled to the connecting rod.

The buffer is fixed to the carriage as follows:—The buffer cylinder is secured by its trunnions to the pivot plug which is inserted into the pivot of the double-decked platform, and the piston rod is attached by the connecting rod to the trail; when the carriage is run up the piston rod is driven into the cylinder, the oil passing to the rear of the piston; when the gun is fired the piston is drawn along the cylinder, and the resistance of the fluid to its passage checks the recoil.

In the hydraulic buffers for siege carriages the size and number of holes in the piston do not vary. There are four holes of 0·35 inch diameter.

The buffer is 5 feet $1\frac{1}{2}$ inches long internally, the piston is 2 inches thick, thus the buffer allows of a possible recoil of 4 feet $11\frac{1}{2}$ inches; practically 4 feet 9 inches should never be exceeded.

—	Charge.	Working quantity.	Quantity to be drawn off.
	lbs.	quarts.	quarts.
Working contents of a buffer, to allow about 4 feet recoil	10	20½	—
	9	19½	1
	8	18½	2
	7	17½	3
	6	16½	4
	5	15½	5
	4	14½	6
	3	13½	7
	2	12½	8

Before action, see that the cylinder contains the requisite quantity of oil, and that there is *no leakage at the gland.*

To fill the cylinder with oil—Run the carriage up, take out the screw plug, and rest the gallon measure in the hole, turn off the cock, and fill the measure with mineral oil to the gallon mark, then turn the cock and allow the oil to flow into the cylinder. Repeat the operation until the buffer is full (5⅛ gallons); then draw off sufficient to reduce the contents to the required quantity.

Dimensions of Carriage.

Height to centre of gun	4 feet 8·5 inches.	
Length { carriage	11 „ 8 „	
Length { axletree	6 „ 3·5 „	
Track of wheels	5 „ 2 „	
Angle of trail	17°	
Weight { carriage	47·25 cwt.	
Weight { hydraulic buffer ..	4·25 „	
	51·5 „	

LIMBER, SIEGE, R.M.L. HOWITZER, L.S., ARMAMENTS, 8-INCH 46-CWT.

(*Plate* IV.)

The limber is the wrought-iron siege limber, common to the beds and carriages of all R.M.L. howitzers in the siege train; the futchels and splinter bar are of wrought iron; the axletree bed is also of wrought iron; and, with the axletree, constitutes a beam of box-girder section.

The wheels are 2nd class "B," No. 25, or 2nd class "C," No. 39. The washer is a "loop washer," having a shorter loop than the usual drag washer.

The limber is fitted with a limber hook steeled, with a piece of steel welded in, to prevent wear, and fitted with a steel key 1¼-inch diameter.

The shafts are one pair "near" and "off," the former being of the field pattern, and the latter similar to the field pattern, but having a loop on the iron for the stay of the outrigger; also another

pair "framed" and attached to the splinter bar. There are outriggers for four-horse draught.

The limber box has a sloping top, and is fitted to carry the stores detailed in packing diagram A.

		cwt.	qrs.	lbs.
Weight	limber	6	3	22
	wheels	4	2	4
	limber box	0	2	2
		12	0	0

PLATFORM, SIEGE, DOUBLE-DECKED, MARK 1.

(*Plate* V.)

The platform consists of two layers of 3-inch fir planks, those of the bottom layer parallel to the line of fire, those of the upper layer at right angles to it. Under the bottom layers are placed four transverse planks, similar to those in the top layer, one at the front, and one at the rear of the platform; the other two dividing the distance between them, one being 4 feet 6 inches from the front, and the other 5 feet 3 inches from the rear transverse plank; distances measured in the clear.

The planks of the upper layer are connected at each end to those below by 5-inch coach screws.

Both layers of planks are connected to the four transverse planks by 8-inch coach screws.

These platforms should be laid at a slope of 1 in 24 (2° 23′) to the front, with a clear space of 1 foot between the front of the platform and the foot of the interior slope.

The object of this arrangement is—

1. To leave a sufficient gangway between the front of the wheels and the interior slope, so as to enable the Officer, or No. 1, who lays the gun, to pass round to the front of the trunnions, when the howitzer is in the firing position to lay "reverse."

2. For convenience of drainage.

3. To prevent the earth and stones shaken down by the shock of firing falling on the platform.

All siege carriages fitted with hydraulic buffers, whether mounted in permanent works or in hastily-constructed positions, will be attached to a central pivot, fixed to the double-decked platform.

The pivot plate is a circular steel casting, with a socket in the centre. It is secured in position by 12 bolts, which pass through the planks and a steel plate on the underside of the platform. The pivot plug is a steel forging in which bearings are formed for the trunnions of the hydraulic buffer.

The buffer is secured in the bearings by two caps.

	cwt.	qrs.	lbs.
Weight of platform with pivot plate ..	43	2	26
„ plug, pivot	2	2	0

PLATE, STEEL, WHEEL, PLATFORM, SIEGE (MARK I).

The wheel plates are of steel, 18 inches by $\frac{1}{2}$ inch by 6 feet. One of these plates is to be placed under each wheel of the carriage to protect the upper layer of the platform, and so that its front edge is in line with the rear edge of the third plank of the platform from the front.

	cwt.	qrs.	lbs.
Weight of each	1	2	4

PLANK, TRAIL, SIEGE (MARK II).

The trail plank is of oak, 12 inches by 3 inches by 6 feet, shod on both sides for the whole of its length with channel steel, and fitted with four rope handles. It is to be placed under the trail of the carriage to preserve the ground platform from injury. It should be placed under the centre of trail, in the line of recoil, the end projecting about 6 inches in front of trail.

Weight, 2 cwt. 1 qr. 7 lb.

CARE AND PRESERVATION.

(*Extracts from "Regulations for Magazines and the Preservation of Artillery Matériel."*)

"(a) *General Instructions.*

"540. In all correspondence and reports relating to carriages, their exact natures, marks, and register numbers should be quoted.

"542. All carriages, slides, and stores connected therewith, forming the armament of fortresses, will be cleaned and painted biennially; but should they be found in a bad state from exposure . . . they will be cleaned and painted every year, and oftener if considered necessary by the O.C.R.A.; on this point, considered as a question of expense, a sound discretion will be exercised.

"542A. The paint used will, at the discretion of the general officer commanding, be of such a colour as to render the carriages as inconspicuous as possible.

"545. In batteries accessible to the public, where no permanent protection is possible, or in works where mountings are not frequently used, all detachable fittings and movable parts of the elevating and other gears will be removed and placed in store, where the bright parts of the ironwork will be well coated with mineral jelly to preserve them from rust. These parts will be thoroughly cleaned and placed in position, at least once in three months, to see that they are in proper working order. All other gears should be worked once a week to ensure their being in a working condition.

"546. In all batteries, when guns or mountings are being overhauled, or dismantled for repairs, all parts, &c., of a portable nature, which are not necessarily required for the purpose of immediate continuation of work, must be placed in the Artillery Store, or other suitable place, for safe custody.

"547. A thorough cleaning and lubricating of all standing working parts must take place once a month, all clotted grease being removed where visible, by scraping, and the parts wiped with an

oily rag. Mountings much exposed, and liable to accumulate dust or sand, should not be left with much grease or oil upon them, but only sufficient to prevent rust, for which a very slight film will suffice. Special care must be taken to prevent grit from getting on the bearing surfaces . . . .

"548. Whenever and wherever fresh lubricant is applied, the old should first be wiped or scraped off, and the parts well worked to distribute the fresh lubricant before leaving them.

"554. A nut or screw should be slightly oiled before being entered, and a few turns given to it by hand before using the spanner, to prevent damage by the threads crossing. A burr on the threads of a screw will prevent it being screwed home, and should be removed A hammer should never be used to tighten up screws or nuts.

"555. Particular attention will be observed when removing or adjusting any gear not to indent or damage the component parts by rough usage. A hammer should never be used unless with a piece of wood or brass to transmit the blow.

"556. Rollers and trucks, and their axles when accessible, will be frequently removed and properly cleaned and greased before being replaced . . . .

"566. The plates and bars of the compressor . . . gears will on no account be greased or oiled, but should be kept free from rust by scraping, as compression adjusted with a scale of rust between the plates may lead to a violent action after the first round.

"578. The buffers should be carefully examined before firing or drill, to see that the cylinders contain the requisite quantity of fluid . . .; that there is no leakage at the glands, and that the piston-rods are properly connected.

"579. If a buffer leaks at the gland, and tightening up the latter does not stop the leak, the packing will be renewed . . .

"726. All the working parts and frictional surfaces should be kept clean and free from rust, clotted oil, and dirt, and be well lubricated with oil. All oil holes should be kept clear. In cleaning the bright parts, care should be taken to avoid the use of coarse grinding materials, such as sand, emery, bath brick, files, &c., which unnecessarily wear away the surfaces and give too much play to the various parts. This particularly applies to the elevating gear and various bearings. The joints of hasps, turnbuckles, and limber-box hinges should be oiled occasionally.

"727. All bolts, screws, and nuts should be kept tightly screwed up, but before inserting them the threads should be oiled. Any bolts, nuts, rivets, screws, or split keys, hasps, turnbuckles, or hinges that are damaged or deficient should be repaired or replaced at once.

"728. In handling gear care should be taken not to indent screws, pinions, spindles, &c. All indents should be neatly removed.

"729. Before repainting the equipment care should be taken that it is put in proper repair; that all blistered paint, dirt, and grease are thoroughly removed.

"730. The equipment will be painted with khaki colour* paint, which is issued prepared ready for use; care must be taken that it is applied thinly and evenly over the surface, and that bright parts are avoided. Before the first coat is applied the surface should be quite dry, and the second coat should not be applied until the first has hardened. If the paint is found to be too thick to flow evenly from the brush, it should be thinned with the best spirits of turpentine.

* See also para. 542A, p. 12.

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"731. On completion of the painting the lettering will be done with black paint in accordance with Regulations.

"*Wheels.*

"753. Felloes slightly split can, in some cases, be strongly repaired by the insertion of screws. Slip spokes or felloes may be inserted for unserviceable ones. When the joints of felloes have shifted, and tires become twisted on the felloes, they should be adjusted on an anvil with a flatter and sledge hammer.

"757. Wheels acquiring too much play on the axletree arm should have a leather or steel washer placed on the axle, at the outer end of the pipe box, between it and the linch pin washer.

"758. The proper greasing of the wheels is of the greatest importance, and officers of batteries should personally see that the pipe boxes of wheels, and axles of vehicles, are kept free from dirt and grit, and properly greased.

"759. When vehicles are in constant use, the wheels and axles should be greased periodically, and, in cases of vehicles in store, the wheels and axles should be kept greased, and be re-greased before being used.

"760. To grease the axle, remove the wheel, and carefully clean all the old grease off the axle and from the inside of the pipe box. Then smear the inside of the pipe box and outside of the axle with fresh grease, and replace the wheel.

"761. It is most important that the old grease should be removed before applying fresh, as the old grease contains small particles of metal and sand, and soon wears the pipe boxes. The metal nave must be kept painted and on no account polished."

(b) *Special Instructions not contained in "Regulations for Magazines, &c."*

To fill the cylinder:—Run the carriage up, remove the filling hole plug, and run the fluid in by means of the gallon measure.

The fluid is withdrawn through the front valve, air being let into the cylinder at the same time through the filling hole.

To remove the packing:—Remove the shackle from the piston rod, unscrew the gland, and with the tang of a file extract the cotton packing; then by withdrawing the rod the remaining portion of the packing, *i.e.*, the metal ring and leather collar will come out with it. Place the new leather on the rod so as not to damage its thin edge, follow it with the metal ring, and press them both home to the bottom of the stuffing box; insert the cotton packing and tighten up the whole with the gland.

The cotton rings should be $\frac{1}{4}$" less in length than the circumference of the piston rod, and the ends must be bound with cotton yarn. When required for use, the ends must be well greased with tallow, and placed in the stuffing box so as to break joint.

CARTRIDGES.

The empty cartridges are of three sizes, and when filled should be of the following dimensions, according to the weight of the charge inserted:—

		Length.	Diameter.	Braids.
In cartridge 7 to 10 lb.	10 lb. ..	8·75″ to 9·25″	6·8″	3
	9 „ ..	7·6″	6·8″	3
	8 „ ..	6·7″	6·8″	2
	7 „ ..	6·0″	6·8″	2
In cartridge 6 to 4 lb.	6 „ ..	6·5″	6·3″	1
	5 „ ..	5·75″ to 6·25″	6·3″	1
	4 „ ..	5·0″	6·3″	1
In cartridge 3 and 2 lb.	3 „ ..	4·0″	6·0″	1
	2 „ ..	3·3″	5·6″	—
	$2\frac{1}{2}$ „†			

The cartridges are made of silk cloth, choked with silk twist, and made up to their proper lengths and diameters by means of braid hoops.

Drill Cartridge.

A dummy cartridge is issued for drill purposes. It is made of wood, covered with raw hide, and is of the same dimensions as the 10 lb. cartridge.

PROJECTILES.

(*Plates* VI *to* IX.)

			Weights (filled and fuzed with gas-check).
Shell	common	Marks I* and II, iron, studded ..	180 lb.
		Marks I and II, iron, studless ..	
		Mark III, cast steel, studless ..	
	shrapnel, Mark I, cast steel, studless		
	star, Marks III and IV		22 lb.
Shot, case, Mark III			74 lb.
Gas-check	with plug, Mark I		4 lb. 8 oz.
	automatic, Mark I		7 lb. 8 oz.

DESCRIPTIONS.

Common Shell.

(*Plates* VI *and* VII.)

The Marks I* and II studded, are of cast iron. There are two rings of four studs each. The Mark II differs from Mark I* in having the hole for the plug passing completely through the base. The latter pattern was not originally intended for a gas check, and the hole has been bored out since. No more studded shells will be made.

The Marks I and II studless shell are made of cast iron, cast with bands and turned to the proper dimensions. The base for a length of ·9 inch is reduced to 5·06 inches diameter, and cast with a circular groove for attaching a gas check; 37 serrations are cast on the base, by which means the gas check imparts rotation to the shell. The head of the shell is struck with a radius of 1·5 diameters, the point being

† For use with star shell only.

truncated, bored out, and screwed 14 threads per inch, to receive a gun metal bush which is bored out and tapped to the G.S. fuze-hole gauge, and recessed ·2 inch below the nose of the shell. In the Mark II the bush is flanged. This is the only difference between the two marks. There are two holes drilled in the head to receive the claws of the extractor.

The body of the Mark III shell is of cast steel, annealed after casting. It is similar to Mark II iron shell, but the head is struck with a radius of 2 diameters.

A hole is bored in the base of Marks II and III, screwed 9 threads to the inch, left handed, and countersunk, to receive a gun metal plug screwed to suit the hole, and having a recess to receive the key.

The interior of the shell is lacquered.

The bursting charges are:—

	P.		F.G.		Total.		
	lb.	oz.	lb.	oz.	lb.	oz.	
Marks I* and II, studded	16	2	3	0	19	2	in serge bag.
Marks I and II, studless..	16	0	2	8	18	8	in dowlas bag.
Mark III, studless ..	22	3	3	12	25	15	,,

Incendiary Stars for Common Shell.

These stars are intended for filling common shells which are to be used for incendiary purposes. Each star consists of a hollow paper cylinder about 2 inches in length, ·7 inch in external diameter, and ·5 inch in internal diameter, soaked in paraffin wax, and filled with the following composition, viz., india rubber solution, 3 oz.; mealed powder, 5 oz.; ground saltpetre, 1 oz.; paraffin wax, ¼ oz.; naphthaline, ¼ oz.; coal tar, 1 oz.; each end of the star is primed with quick-match. The stars are tied up in paper bundles of eight each and packed in quarter metal lined cases or loose in metal-lined boxes.

Shrapnel Shell.

(*Plate* VII).

The body of the shell is made of cast steel, annealed after casting. It is cast with bands and turned to final dimensions. The base for a length of ·9 inch is reduced in diameter, with a circular groove for attaching the gas check; 37 serrations are cast on the base, by means of which the gas check imparts rotation to the shell. A hole is bored in the base and screwed 14 threads to the inch, left hand, and countersunk, into which is fitted a gun metal plug, screwed to suit the hole, and having a recess for the key.

The head is made of charcoal iron, or Bessemer metal, and is struck with a radius of 2 diameters, the top being truncated to receive a gun metal socket, which is screwed to G.S. fuze hole gauge, and attached to the head with solder. The head is fitted with a wooden block, and attached to the body of the shell by 12 rivets; 6 pins are also inserted to prevent the head twisting; the holes for these twisting pins are slotted through to the bottom of the head. The rivets and twisting pins are covered with solder brought up to correct outline.

Two holes are drilled in the head, into which tin cups are fitted to receive the claws of the extractor.

The shell has a disc of steel, with a hole screwed in the centre to receive a gun metal tube, placed over the powder chamber, and resting

on the shoulder formed to receive it, the disc is imbedded on its seat with red lead.

The powder chamber is much larger than in the ordinary type of shrapnel; it is lacquered, and contains a bursting charge of 2 lb., which is inserted through the base.

A gun metal or brass tube screwed at the lower end fits into the steel disc, whilst the upper end is fitted with a short tube screwed to receive a primer; the upper part of this tube is connected with the fuze socket by means of a conical tin tube.

The inside of the shell is lined with brown paper, and contains 540 mixed metal balls (14 to the lb.), the interstices being filled in with melted resin.

Star Shell.

(*Plate* VIII.)

Mark IV shell is made of two hemispheres of Bessemer metal 0·259 inch thick, tinned all over, and fitted together with a lap joint, the inside of each hemisphere being strengthened by a wrought-iron ring.

The upper hemisphere is fitted with a gun metal socket for a wood time fuze, and the lower hemisphere is fitted inside with a wooden disc and ring primed with quickmatch. The two hemispheres are secured together by six screws and six twisting pins. In order to keep the fuze hole in an axial position when loading, a ring of yellow pine is glued and soldered on to the lower hemisphere.

The shell contains 31 stars, filled with improved magnesium light composition. Each star has a small hole in each end primed with quickmatch and sulphur to ensure their simultaneous ignition, and each is bound over the ends and several times round the body with soft copper wire to prevent its breaking up in the shell.

Mark III shell contained only 21 stars, filled with magnesium signal light composition, and the wooden ring on the outside was less securely fastened.

This shell will be fired with a 2½-lb. charge, and 15 seconds wood time fuze, with special gun cotton priming. As a rule it should burst about 100 feet above the plane, so as to ensure sufficient dispersion of the stars before reaching the ground.

15 degrees elevation, and fuze bored at 10, gives about 900 yards range.

35 degrees elevation, and fuze full length, gives about 1700 yards range.

Case Shot.

(*Plate* IX.)

This shot is made of tinned iron in one piece, riveted longitudinally, and fringed at both ends. The bottom fringe is bent down and riveted to the sheet iron bottom, and when the case is filled the upper end is bent over and soldered to the tinned iron top. An iron handle is attached to the top by iron staples, which are bent round to form a loop, and riveted to the inside of the head. In the interior of the cylinder is a wrought iron disc lying loosely on the bottom, and on this stand three wrought iron segments forming a lining to the case. The contents are 75 sand shot of 8 oz., weighing 36 lb. 7½ oz., and 9 lb. 8 oz. of clay and sand.

Gas Checks.

(*Plate* VII.)

Both gas checks are of copper, and have the rim made with four projections, which are planed to the same twist as the studs on the shell. The gas checks have eight fire holes, ·2 inch diameter, which pass through the side of the rim. These are for the purpose of allowing the passage of sufficient flame to ignite the time fuze. The gas check is attached to the studded shell by means of a metal plug fitted with an hexagonal head requiring a special "spanner gas check plug."

The studless common and the shrapnel shell take an automatic gas check, which is formed somewhat like a soup plate to fit, on shock of discharge in the howitzer, on the base of the shell, which is prepared with serrations, &c., to receive it.

INSTRUCTIONS FOR PREPARATION OF SHELLS.

Extracts from "Regulations for Magazines, &c."

"Fixing Gas Checks to Studded Projectiles.

"339. Unscrew the plug and remove it. Place the gas check on the base of the projectile with the concave, or unpainted side, next the base; . . . insert the plug, and screw it well home with the spanner until it binds against the gas check.

"340. . . . See that the projections are in the line of the studs. . . .

"Fixing Gas Checks to Studless Projectiles.

"341. These gas checks are placed in the bore . . . loose, and become fixed to the projectile when the howitzer is fired. . .

"342. For drill purposes, in order to facilitate unloading, the gas check should be attached to the base of the shell by indenting it with a blunt tool at two or three points in that part which surrounds the neck of the projecting base of the projectile.

"Fixing Plugs and Fuzes.

"345. When plugs or metal fuzes are screwed into shells taking nose fuzes, they will, unless required for immediate use, be lubricated with a mixture composed of equal parts (by weight) of Mark III luting and mineral jelly. The mixture is to be applied to the threads of the fuze or plug with a brush in sufficient quantity to cover them, care being taken that it does not extend over the bottom. A coat of paint of the same colour as the tip of the shell will be applied over the junction of the plug and shell when the latter is filled.

"346. Projectiles fitted with . . . plugs, and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water or otherwise, should have the plugs that are not covered by wads or lead discs occasionally unscrewed, and re-lubricated as above, a coat of paint being applied over the junction of the plug and shell, care being taken that this is only done when the hygrometric conditions are favourable. No plugs will be removed whilst moisture is condensing on the outside of the shell.

"347. Instances have occurred in which fuze hole plugs of common shells have been so jammed in as to be immovable, in consequence of

using the "Wrench, base plug." The "Key, fuze and plug G.S.," the "Key, plug, G.S.," or the "Key, fuze, universal," are the only implements which should be used for screwing in the G.S. plug.

"*Distinguishing Marks.*

"366. Projectiles will be painted and marked as follows:—

"(1) *Tips*:—

"Common shell . . .—To have black tips.

. . . . . .

"Shrapnel shell.—To have red tips.

"(2) *Bands*:—

"Steel projectiles.—To have white band round head. except . . . shrapnel . . . shells.

"All filled shells.—To have red band round head.

"Projectiles manufactured for or sentenced for practice only (being unfit for service purposes).—To have yellow band round body, and stamped with letter P on the base.

"(3) *Bodies*:—

"Lyddite shells to be yellow . . . all other projectiles to be black.

The letters "C.S." are stamped on the base of cast steel shells.

"367. The following additional markings, in red paint, will be shown on all shells excepting lyddite . . .:—

(*a*) The word "fuzed" if the shell is fuzed.
(*b*) The word "Bag," if one has been used.
(*c*) The monogram of the station.
(*d*) The date of filling.
(*e*) A 1-inch disc, if shalloon primers have been inserted.
(*f*) The letters P. or Q.F. (1½ inches long) . . . if filled with P. and F.G. or Q.F. and F.G.

"368. The sizes of the type (except as in (*f*)) will be:—

Over 4-inch .. .. ¾ inch.

The tips will be 1 inch deep in projectiles fitted for nose fuzes, but the same stencil being used for sharp-nosed projectiles, the tips on the latter will be correspondingly wider. The bands will be ½ inch wide, the white band, denoting steel, being immediately below the tip, and the red one denoting filled, ½ an inch lower.

"*Filling Shells with Incendiary Stars.*

"419. The stars are put in through the fuze hole, the intervals between them when in the shell being filled with shell L.G., which should be inserted from time to time during the filling."

FUZES.

Plates X *to* XIII.

Direct Action, No. 1, Mark II.
" delay No. 10 for high angle fire.
Time Sensitive, middle, No. 24.
Time, 15 seconds M.L. special priming, No. 42.

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Fuze, Percussion, Direct Action, No. 1.

(*Plate* X.)

This fuze is intended to act on direct impact; it cannot be depended on to act on graze unless fired at angles of elevation of 10° and upwards.

It is made of gun metal, turned all over, and screwed below the head to fit G.S. fuze hole. The interior is bored out at the lower end for the powder charge, and closed with a screw base plug. A recess in the upper part of the fuze is charged with detonating composition, and the holes communicating with the magazine are filled with powder priming. The fuze is fitted with a steel needle, passing through and secured in a copper suspending disc ·032 inch thick. The lower part of the fuze is filled with pistol or R.F.G.[2] powder. A gun metal cup having a T-shaped slot cut out in each side to fit over the projecting pins in the head of the fuze, is secured over the top.

On striking any object, the suspending disc is driven in, and the needle is forced against the detonating composition, thereby exploding the fuze.

Weight ... . $7\frac{3}{4}$ oz.

These fuzes are issued 5 in a tin cylinder.

Percussion, Direct Action, Delay, No. 10, Mark III.

(*Plate* XI.)

This fuze is generally similar to the "Fuze, percussion, direct action, No. 3, Mark II," but has a delay arrangement in addition, consisting of a channel filled with compressed mealed powder, the top being primed with quickmatch and the bottom communicating with the magazine. It differs externally in being slightly longer.

It should not be fired with less than 30° elevation, as the projectile might ricochet.

On impact, the disc with needle is driven in on the detonator; the flash is then led to the delay arrangement by means of the quickmatch. The pressed pellet of mealed powder, the burning of which gives the delay, is thus ignited, and burns about five seconds, then ignites the fuze magazine of loose powder, which fires the shell burster.

Weight .. .. 10 oz.

These fuzes are issued 1 in a tin cylinder.

Time, Sensitive, Middle, No. 24, Mark I.

(*Plate* XII.)

The fuze consists of the following parts:—

Body with stem, lighting pellet, two retaining pellets, two spiral springs, needle, composition ring, dome, cap, two safety pins, base plug, and axial magazine filled with M.G.[1] powder.

All the parts are made of gun metal.

The composition ring is graduated on its periphery from 0 to 30, and reads to quarter units. An ψ is stamped on the ring to show the safety point, and when this coincides with the ⅄ on the body the fuze is set at safety. The cap, which screws on to the top of the stem, is made hexagonal, to fit the "Key, fuze, universal."

The fuze is set by loosening the screw cap *a* on the top of the stem, by means of the "Key, fuze, universal," and turning the dome

and ring till the required graduation on the latter coincides with the arrow head on the body, then tighten the screw cap.

The safety pins are withdrawn at the moment of loading. On discharge the centrifugal action causes the retaining pellets to fly out, releasing the lighting pellet, which flies by centrifugal force against the needle, firing the detonator, which ignites the powder in the pellet and axial magazine, this latter lighting the quickmatch in the composition ring.

Weight	1 lb. 4 oz.
Time of burning at rest	14·6 to 15·8 secs.

These fuzes are issued 1 in a tin cylinder.

Time, 15 Seconds, M.L., Special Priming, No. 42, Mark I.

(*Plate* XIII.)

The fuze is made of beech wood turned to a cone of 1 in 9·375 inches. The interior is bored out to within 0·25 inch of the bottom, and fitted with a brown paper cylinder containing fuze composition and pressed mealed powder, and the top closed with a screw plug of gunmetal, having a copper pin projecting to hold the bights of the quickmatch priming. Two escape holes are bored through the side of head through which the quickmatch priming is passed, wound round the head and covered with strands of guncotton priming, and the head covered with a cap of fine white paper. Six rows of side holes are bored at right angles to the axis of the fuze, and six channels are bored in line with the side holes and parallel to the axis; the channels are filled with pistol powder and connected at the base by quickmatch; the side holes are filled with pistol powder pressed, and covered with fine white paper.

An index paper graduated to 30, and showing by yellow dots the position of the side holes, is pasted round the body of the fuze, and the surface is varnished.

A copper band covered with tape is secured round the head of the fuze. The head is painted red, and the end of the band white.

Time of burning at rest, 14·6 to 16·5 seconds.

These fuzes are prepared for any desired time of flight by boring through the side hole corresponding to the required time, into the composition.

The fuzes are fixed in the fuze hole by screwing them round by hand until they are held firmly in the fuze hole; they must not be fixed by tapping with a mallet, or striking the fuzes, previously inserted loosely in the shell, against any hard object. Such action would tend to crack the fuze and cause a premature explosion. They must not be uncapped until the shell is placed in the muzzle of the howitzer. This is done by taking hold of the exposed end of the copper band, and unwinding from *right* to *left*, smartly, so as to thoroughly detach the band from the head of the fuze, and to leave the priming fully exposed. The extra priming of dry guncotton should not be disturbed.

Note.—For this equipment the foregoing fuzes are intended to be used as stated below:—

Direct action, No. 1 } with common shell.
„ „ delay, No. 10 }
Time, sensitive, middle, No. 24, with shrapnel shell.
Time, 15 seconds, M.L., No. 42, with star shell.

TUBES.

Tubes, Friction, Copper, Solid Drawn, with Ball, Mark II.

(*Plate* XIV.)

The tube is made of solid drawn copper, and has a solid head; it is filled with pistol powder, and the bottom is closed by a brass ball over which is a cork plug, secured by shellac. The length is 2·1 inches. A hole is bored through one side of the tube, having its centre about 0·25 inch below the top, and through this hole projects a copper nib-piece, with a small hole bored in it to allow the flash to reach the powder in the tube. This nib-piece contains a roughened copper friction bar, which is smeared with a detonating composition of chlorate of potash, sulphur, and sulphide of antimony, and the nib-piece is pinched down upon the friction bar, the projecting part of which has a vertical eye, into which the hook of the lanyard fits. On pulling the lanyard the friction bar is drawn out, igniting the composition and firing tube. The gas from the exploded cartridge drives the tube out of the vent.

RANGE TABLES for 8-inch R.M.L. Howitzer of 46 Cwt. with Projectile fitted with Gas-check.

Charge, 10 lb.

Range.	Elevation.	Deflection. Left.	Fuze Scales. Middle. Sensitive.*	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range.	Drift.	Time of Flight.
yards.	° ′	° ′		yards.	yards.	yards.	seconds.
400	2 0	0 8	3·4	14·3	0·56	0·9	1·7
500	2 35	0 13	4·4	14·3	0·70	1·8	2·1
600	3 10	0 17	5·4	14·3	0·83	2·8	2·6
700	3 50	0 21	6·4	12·5	0·97	4·0	3·0
800	4 30	0 24	7·5	12·5	1·11	5·3	3·6
900	5 10	0 26	8·6	12·5	1·25	6·6	4·1
1000	5 50	0 29	9·6	12·5	1·39	8·0	4·6
1100	6 30	0 31	10·7	12·5	1·53	9·5	5·1
1200	7 10	0 33	11·7	12·5	1·67	11·0	5·6
1300	7 50	0 35	12·7	12·5	1·80	12·7	6·1
1400	8 35	0 37	13·7	11·1	1·94	14·5	6·6
1500	9 20	0 39	14·8	11·1	2·08	16·4	7·1
1600	10 5	0 42	15·8	11·1	2·22	18·5	7·6
1700	10 55	0 44	16·8	11·1	2·36	20·7	8·1
1800	11 35	0 46	17·9	11·1	2·50	22·9	8·6
1900	12 20	0 48	18·9	11·1	2·64	25·2	9·1
2000	13 5	0 50	19·9	11·1	2·78	27·6	9·6
2100	13 55	0 52	21·0	10·0	2·92	30·6	10·2
2200	14 45	0 55	22·1	10·0	3·06	33·7	10·8
2300	15 35	0 58	23·2	10·0	3·20	37·3	11·3
2400	16 30	1 2	24·5	9·1	3·34	41·5	11·9
2500	17 25	1 6	25·7	9·1	3·48	45·5	12·5
2600	18 25	1 11	27·0	8·3	3·61	51·0	13·1
2700	19 25	1 16	28·3	8·3	3·75	57·0	13·7
2800	20 30	1 23	29·7	8·0	3·89	64·0	14·4
2900	21 40	1 29		7·1	4·03	72·0	15·2
3000	22 50	1 37		7·1	4·17	81·0	16·0
3100	24 0	1 45		7·1	4·31	90·0	16·7
3200	25 15	1 53		6·6	4·44	100·0	17·4
3300	26 45	2 1		5·5	4·58	111·0	18·3
3400	28 25	2 10		5·0	4·72	123·0	19·3
3500	30 15	2 21		4·5	4·86	137·0	20·4
3600	32 25	2 33		3·8	5·00	154·0	21·6
3700	35 0	2 51		3·2	5·13	176·0	23·1
3800	38 15	3 11		2·6	5·27	204·0	24·9

* This fuze scale also serves for 15 sec. wood time fuze with special priming, the nearest division on the latter being taken.

CHARGE, 9 lb.

Range.	Elevation.		Deflection.		5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range.	Drift.	Time of Flight.
yards.	°	′	°	′	yards.	yards.	yards.	seconds.
400	2	10	0	4	12·5	0·56	0·5	1·7
500	2	55	0	12	11·1	0·70	1·7	2·2
600	3	40	0	18	11·1	0·83	3·0	2·7
700	4	25	0	22	11·1	0·97	4·4	3·2
800	5	10	0	26	11·1	1·11	5·8	3·7
900	5	55	0	29	11·1	1·25	7·3	4·2
1000	6	40	0	31	11·1	1·39	8·8	4·7
1100	7	25	0	34	11·1	1·53	10·4	5·2
1200	8	15	0	36	10·0	1·67	12·1	5·8
1300	9	5	0	38	10·0	1·80	14·0	6·4
1400	9	55	0	41	10·0	1·94	16·0	7·0
1500	10	45	0	43	10·0	2·08	18·1	7·6
1600	11	35	0	45	10·0	2·22	20·3	8·1
1700	12	25	0	47	10·0	2·36	22·5	8·7
1800	13	20	0	50	9·1	2·50	25·0	9·3
1900	14	25	0	52	9·1	2·64	27·8	9·9
2000	15	20	0	55	9·1	2·78	30·8	10·5
2100	16	15	0	58	9·1	2·92	34·0	11·1
2200	17	15	1	1	8·3	3·06	37·5	11·7
2300	18	15	1	4	8·3	3·20	41·2	12·3
2400	19	15	1	7	8·3	3·34	45·0	12·9
2500	20	30	1	12	8·0	3·48	50·0	13·6
2600	21	40	1	16	7·1	3·61	55·0	14·4
2700	23	5	1	22	5·9	3·75	61·5	15·2
2800	24	35	1	28	5·5	3·89	69·0	16·1
2900	26	15	1	36	5·0	4·03	77·5	17·1
3000	28	5	1	46	4·5	4·17	88·5	18·1
3100	30	10	1	58	4·0	4·31	102·0	19·3
3200	32	30	2	13	3·6	4·44	119·0	20·6
3300	35	15	2	33	3·0	4·58	141·0	22·0
3400	38	30	2	57	2·6	4·72	168·0	23·7

CHARGE, 8 lb.

Range.	Elevation.		Deflection.		5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	°	′	°	′	yards.	yards.	yards.	seconds.
400	3	5	0	11	10·0	0·56	1·3	2·1
500	3	55	0	18	10·0	0·70	2·5	2·7
600	4	45	0	23	10·0	0·83	3·9	3·3
700	5	35	0	28	10·0	0·97	5·5	3·8
800	6	25	0	31	10·0	1·11	7·1	4·3
900	7	25	0	35	10·0	1·25	8·8	4·9
1000	8	10	0	38	10·0	1·39	10·6	5·4
1100	9	5	0	40	9·1	1·53	12·5	6·0
1200	10	0	0	43	9·1	1·67	14·4	6·6
1300	10	55	0	45	9·1	1·80	16·4	7·2
1400	11	50	0	47	9·1	1·94	18·6	7·8
1500	12	45	0	50	9·1	2·08	20·9	8·3
1600	13	45	0	52	8·3	2·22	23·3	8·9
1700	14	45	0	54	8·3	2·36	25·8	9·5
1800	15	45	0	56	8·3	2·50	28·4	10·1
1900	16	50	0	59	8·0	2·64	31·4	10·8
2000	18	0	1	2	7·1	2·78	34·8	11·5
2100	19	20	1	6	6·6	2·92	38·8	12·2
2200	20	40	1	10	6·6	3·06	43·0	13·0
2300	22	5	1	14	6·3	3·20	47·5	13·8
2400	23	35	1	19	5·9	3·34	53·0	14·7
2500	25	20	1	24	4·7	3·48	59·0	15·6
2600	27	10	1	32	4·5	3·61	67·0	16·6
2700	29	20	1	41	3·8	3·75	76·0	17·7
2800	31	45	1	54	3·5	3·89	89·0	19·0
2900	35	0	2	12	2·6	4·03	107·0	20·6
3000	39	0	2	42	2·1	4·17	135·0	22·5

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CHARGE, 7 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	3 25	0 4	9·1	0·56	0·5	2·1
500	4 20	0 14	9·1	0·70	2·0	2·7
600	5 20	0 21	8·3	0·83	3·6	3·3
700	6 20	0 27	8·3	0·97	5·3	3·9
800	7 20	0 31	8·3	1·11	7·1	4·5
900	8 20	0 35	8·3	1·25	8·9	5·1
1000	9 20	0 38	8·3	1·39	10·8	5·7
1100	10 20	0 41	8·3	1·53	12·8	6·3
1200	11 25	0 44	8·0	1·67	14·8	6·9
1300	12 35	0 47	7·1	1·80	17·0	7·6
1400	13 45	0 50	7·1	1·94	19·5	8·2
1500	14 55	0 53	7·1	2·08	22·0	8·9
1600	16 15	0 56	6·3	2·22	25·0	9·6
1700	17 35	1 0	6·3	2·36	28·5	10·4
1800	19 5	1 4	5·5	2·50	32·0	11·2
1900	20 40	1 8	5·2	2·64	36·0	12·0
2000	22 25	1 12	4·8	2·78	40·0	12·9
2100	24 25	1 18	4·2	2·92	45·5	13·9
2200	26 30	1 25	4·0	3·06	52·0	15·0
2300	28 50	1 33	3·6	3·20	60·0	16·2
2400	31 30	1 45	3·1	3·34	70·0	17·6
2500	35 0	2 2	2·6	3·48	85·0	19·2
2600	38 40	2 27	2·3	3·61	106·0	20·8

CHARGE, 6 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	4 30	0 13	7·7	0·56	1·50	2·6
500	5 35	0 22	7·7	0·70	3·00	3·2
600	6 45	0 28	7·1	0·83	4·75	3·8
700	7 55	0 33	7·1	0·97	6·50	4·4
800	9 5	0 38	7·1	1·11	8·50	5·0
900	10 15	0 42	7·1	1·25	10·50	5·7
1000	11 30	0 45	6·7	1·39	12·50	6·4
1100	12 50	0 48	6·2	1·53	14·75	7·1
1200	14 15	0 51	5·9	1·67	17·25	7·8
1300	15 45	0 55	5·5	1·80	20·00	8·6
1400	17 15	0 58	5·5	1·94	22·75	9·4
1500	18 55	1 2	5·0	2·08	26·00	10·2
1600	20 45	1 7	4·5	2·22	29·75	11·1
1700	22 45	1 11	4·1	2·36	33·75	12·1
1800	25 0	1 17	3·7	2·50	38·75	13·1
1900	27 30	1 25	3·3	2·64	44·75	14·3
2000	30 25	1 34	2·9	2·78	52·25	15·6
2100	33 45	1 46	2·5	2·92	62·00	17·1
2200	39 0	2 12	1·5	3·06	81·00	19·3

CHARGE, 5 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	5 40	0 31	7·1	0·56	3·5	2·9
500	7 0	0 36	6·3	0·70	5·0	3·5
600	8 20	0 39	6·3	0·83	6·5	4·2
700	9 45	0 41	6·0	0·97	8·0	4·9
800	11 10	0 45	6·0	1·11	10·0	5·6
900	12 45	0 48	5·3	1·25	12·0	6·3
1000	14 30	0 51	4·8	1·39	14·3	7·1
1100	16 15	0 55	4·8	1·53	16·8	8·0
1200	18 25	1 0	3·8	1·67	20·0	9·0
1300	20 35	1 5	3·8	1·80	23·5	10·0
1400	23 0	1 10	3·5	1·94	27·5	11·0
1500	26 0	1 17	2·8	2·08	32·5	12·2
1600	29 30	1 28	2·4	2·22	39·5	13·7
1700	33 30	1 41	2·1	2·36	48·0	15·3
1800	39 0	2 2	1·5	2·50	61·0	17·4

CHARGE, 4 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	8 0	0 45	6·3	0·56	5·0	3·5
500	9 30	0 46	5·6	0·70	6·5	4·2
600	11 10	0 49	5·0	0·83	8·3	4·9
700	13 0	0 52	4·5	0·97	10·2	5·6
800	15 0	0 56	4·2	1·11	12·4	6·4
900	17 20	1 0	3·6	1·25	15·0	7·4
1000	20 0	1 4	3·1	1·39	18·0	8·5
1100	23 0	1 12	2·8	1·53	22·0	9·7
1200	27 15	1 24	2·0	1·67	28·0	11·3
1300	32 0	1 36	1·7	1·80	35·0	13·0
1400	38 15	1 58	1·3	1·94	45·0	15·2

CHARGE, 3 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	10 45	1 8	3·8	0·56	7·5	4·0
500	13 50	1 8	3·5	0·70	9·3	4·9
600	16 15	1 10	2·9	0·83	11·6	5·9
700	19 30	1 15	2·6	0·97	14·5	7·0
800	23 45	1 22	2·1	1·11	18·2	8·4
900	29 0	1 33	1·6	1·25	23·2	10·2
1000	38 0	2 0	0·9	1·39	33·2	12·9

CHARGE, 2 lb.

Range.	Elevation.	Deflection.	5 minutes' Elevation increases or decreases the Range by	5 minutes will alter Point of Impact vertically or laterally at each Range	Drift.	Time of Flight.
yards.	° ′	° ′	yards.	yards.	yards.	seconds.
400	18 15	1 42	2·00	0·56	11·0	5·4
500	24 0	1 44	1·44	0·70	14·5	6·9
600	35 0	2 12	0·75	0·83	22·0	9·6

DRILL.

Travelling Carriage fitted with Hydraulic Buffer.

The detachment consists of 10 Nos., and falls in two deep. It is told off, marched into the battery, and halted in line, facing the parapet and to the left rear of the platform. It is now in the position of "detachment rear."

To Take Post under Cover.*

Officer.	*No.* 1.
Take post under cover.	*Double march.*†

The numbers double to their places as follows:—2 and 4 on the right of the howitzer, 3 and 5 on the left of the howitzer close to the parapet and facing the rear, 2 and 3 next the muzzle, 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 going to the cartridge store; 7, 9, and 10 to the shell store.

General Duties.‡

1 commands, tests the clinometer, superintends the fixing of fuzes, assists to run up, records the readings of sights and clinometer, and lays.

2 supplies himself with side arms, searches, assists to lift projectile, rams home, runs up, traverses and sponges.

3 loads, assists to raise projectile, uncaps or removes safety pin from fuze when in the bore, rams home, runs up and traverses.

4 runs up and elevates.

5 supplies gas-checks to 3, runs up, makes ready, fires and attends to vent.

6 supplies 3 with cartridges.

7 attends to fuzes, brings up projectile in bearer and lifts it to the muzzle.

8 attends to magazine or cartridge store, and serves out cartridges.

9 assists 7 in all his duties, and returns empty bearer.

10 attends to shell store, and issues shells, tubes, and fuzes.

To Prepare for Action.

Officer.	*No.* 1.
Prepare for action.	*Prepare for action.*

* If the howitzer is not behind a parapet and the word of command is "*Take post at the howitzer,*" 2 and 3 halt in line with the front of the wheels, 4 and 5 with the rear of the wheels, 1 in rear of the howitzer, 6, 7, 8, 9, and 10 at the limber

† All words of command given by the No. 1 should be prefaced by the number of his howitzer.

‡ When from any cause the No. 1 is not the layer, 2 will command, superintend the fixing of fuzes, assist to run up, and elevate; 4 will test the clinometer, run up, record readings of sights and clinometer, and lay.

"*Prepare for Action.*"—The stores are brought up as follows:—

1, handspike, sights, clinometer, piece of chalk, and 50 feet tape.

2, large scotch, handspike, and assists **4** with side arms.

3, large scotch, handspike, two banderols, removes the tampeon from the muzzle.

4, handspike, elevating wheel, side arms, and support for head of side arms.

5, handspike, tubes in pocket, lanyard, pricker, and vent-server.

6, two cartridge cases, which he leaves at the cartridge store, bucket filled, and brush. (For drill purposes two drill cartridges.)

7, fuzes, and fuze and shell implements. He obtains the fuze boxes from **10**, having ascertained from **1** the fuzes required, and satisfies himself as to the correctness of fuzes and fuze implements.

8 prepares to issue cartridges.

9 brings up a shell-bearer and brush, also gas checks in box, with lid unscrewed.

10, hammer and file for removing burrs on gas checks, &c. He goes to the shell store and prepares to issue shells, friction tubes, and fuzes. He examines the shells carefully, cleans them if necessary, and loosens the fuze-hole plugs of shells that will be first issued.

The stores having been brought up, **1** will satisfy himself that the foresights fit properly on the howitzer, and the horizontal bars of the sights work easily; he receives the reports from the Nos. responsible of any irregularity or deficiency in connection with the howitzer, ammunition, or stores; he will ascertain that the buffer contains the correct amount of oil, and will see the platforms swept, and sand bags arranged, if necessary, for the loading number to stand on.

The sponge and rammer are laid on the ground clear of the platform, to the right of the howitzer, and parallel to it, heads to the rear, resting on the support supplied by **4**, rammer nearest the howitzer. The wadhook and extractor are laid on the ground clear of the howitzer.

The sponge bucket is placed near the sponge head.

The handspikes are laid down, two on each side of the howitzer close to the carriage, points to the front, bevelled side uppermost, those of **2** and **3** outside, and about 2 feet in advance of those of **4** and **5**. **1**'s handspike in rear of the platform.

3 examines the bore to see that the grooves are free from grit.

4 ascertains that the elevating gear is in working order (should the elevating arc have been detached from the carriage he brings it up and adjusts it).

5 straps the tube pocket round his waist on the right side, coils up the lanyard, and passes the bight of it through the tube-pocket strap; examines the vent server and places it in the vent, the loop of the vent server lanyard over one of the sights; he fills his tube pocket with friction tubes which he procures from **10**, places the pricker in the loop on the carriage, and sees that the automatic gas checks are placed in a convenient position.

N.B.—Should the stores be on the howitzer, they are unstrapped and laid down as above detailed.

5 drifts the vent, replaces the pricker in the loop and the vent server; **2** supplies himself with the wadhook, searches the howitzer after the pricker has been withdrawn, and replaces the wadhook. He then supplies himself with the sponge, sponges out and re-

places the sponge. 4 attends to the elevating wheel to bring the howitzer into the position for loading.

1, assisted by 4, tests the clinometer, and reports error, if any, to his group officer.

The howitzer should be at about 5° of elevation to facilitate uniform ramming home, and a mark is made on the piece in line with the horns of the travelling trunnion holes, so that for future rounds the piece may be readily got into the same position. 1 will clamp his sights with the sliding leaves at the 4th graduation, and at zero of the deflection scale.

To Load.

Officer.	*No.* 1.
*With.....load.**	*With.....load.*

"*Load.*"—1 gives 7 the nature of shell and fuze required. He places himself in a convenient position near the muzzle, whence he can watch the loading and observe by the mark on the rammer if the shell is home. He records elevation and deflection ordered.

2, having supplied himself with the rammer, places himself in a convenient position for ramming home. He places his left foot in line with and about 12 inches from the muzzle, steps to his right with his right foot and takes the rammer in a horizontal position right hand about the centre back down, left as near the head as possible, back up. The rammer stave should be marked so as to show when the round is "home," and a second mark should be made one foot nearer the head. As soon as the cartridge is put in he rams it home; he then springs the rammer and rests it inside the wheel against the carriage. After the gas check has been placed in the bore, he assists to place the projectile in the bore, and resuming the rammer he with 3 rams home hand over hand till the first mark comes against the muzzle. 2 and 3 then halt and reach out as far down the stave as they can and wait for the word "*Home*" from 1. On that word 2 and 3 ram home together, throwing all their weight back on the rammer, and keeping their arms straight, 2 then springs the rammer, steps out, replaces it and goes under cover.

3 takes the cartridge from the cartridge case with his left hand moves up and places it in the bore, being careful that the seam of the cartridge does not come under the vent; should the choke of the cartridge be long enough the head of the rammer should be pressed on the surplus material in ramming home to prevent the cartridge turning over. When the cartridge has been rammed home, he receives a gas check from 5, and places it in the bore,† painted side to the rear; he then assists 7 and 9 to lift the projectile, and place it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2, and assists him to ram home. When the projectile is home he quits the stave and goes under cover.

5 hands a gas check to 3.

6 brings up a cartridge in a case and places it on the ground on 3's right front, uncovers it, and as soon as 3 has withdrawn the cartridge, takes the case back to the cartridge store.

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* If the command is "*With shell, load*" common shell and percussion fuze is implied.

† See page 18.

7 and **9** bring up projectile in bearer, having fixed the fuze according to **1**'s directions, and assisted by **2** and **3** place it in the bore; **9** removes the empty bearer.

8 issues a cartridge to **6**.

10 issues a shell to **7** and **9**.

To Run up.

Directly the howitzer is loaded **1** gives "*Run up*," and applies his handspike between the brackets of the trail to guide the howitzer, so that the right wheel may touch the pivot.

2, **3**, **4**, **5**, take up their handspikes; **2** and **3** unscotch and apply theirs horizontally over the spokes of the wheels in front and under the bracket, close to the breast, and bear down; **4** and **5** use theirs as levers of the second order under the rear part of the wheels. All four numbers face to the rear.

When the howitzer is run up **1** gives "*Halt*," slides his handspike to the rear, clear of the recoil, and the numbers withdraw their handspikes and go under cover. **1** reports "*Run up*" to his group officer. The line of fire is now obtained.

Officer.	*No.* **1.**
Pick up the line of fire from the front (rear or flank).	*Pick up line of fire.*

(*a.*) From the front—as in Siege Artillery Drill, **4** holding up a banderol or wadhook at the howitzer close to the sliding leaf of the foresight, and **2** and **3** taking banderols to the front, **3** being nearest to the piece.

(*b.*) From the rear—as in Siege Artillery Drill, **4** holds up a banderol as above.

(*c.*) From the flank—as in Siege Artillery Drill.

As soon as the banderol is placed in rear in the line of fire, the numbers double under cover.

To Lay the Howitzer.

Officer.	*No.* **1.**
	Take post to lay.

1 places himself inside the wheel in front of the foresight, ready to lay back. **2** and **3** pick up their handspikes and go to the end of the trail, facing the front, ready to traverse; **4** goes to the elevating wheel; **5** prepares a tube; **1** lays back on the banderol.

Officer.	*No.* **1.**
	Trail right. *Trail left.* *Halt.* *Under cover.*

At "*Trail right*" **3** heaves over the trail; at "*Trail left*," **2**, till the word "*Halt.*"

When the piece is approximately in the line of fire, and it is necessary to adjust the trail plank, **2** and **3** place their handspikes

under the trail eye, and raise it, while **1** and **5** shift the plank. The proper position for the plank is under the centre of the trail, the end projecting about 6 inches in front of the trail. The plank should be in the line of recoil.

When it is necessary to adjust the wheel plates, all the numbers will stand round the trail and lift, except **1**, who arranges the large coin so that, resting on its broad end under the axletree, it may form a fulcrum when the trail is borne down, and lift the wheel while the wheel plate is being adjusted. The proper position for the wheel plate is with its front edge about in line with the rear edge of the third plank of the platform from the front, and parallel with the line of recoil.

The piece is accurately laid for line after the trail plank and wheel plates have been adjusted, and on the word "*Under cover,*" **2** and **3** lay down their handspikes and go under cover.

1 will then take the inclination of the trunnions with clinometer on the cascable plane, and report it to the Group Officer, and pick up an auxiliary mark as explained in Siege Artillery Drill, noting the details on the piece.

The piece is then laid with the deflection ordered on the auxiliary mark, and for elevation, by clinometer.

Officer.	*No.* **1.**
	Elevate.
	Depress.
	Halt.
	Under cover.

At "*Elevate*" or "*Depress,*" **4** turns the wheel in the required direction till the word "*Halt*" is given. He goes under cover on completion of the laying. **1** removes the clinometer and places it in its box, takes out the tangent sight, which he holds in his hand, and should no order to fire be given goes under cover.

If it is necessary to run back; at "*Run back,*" **2** and **3** apply their handspikes in front of the wheels using them as levers of the second order, **4** and **5** take a purchase with theirs over the most horizontal spokes in rear and under the brackets; the whole facing the rear.* As soon as the piece is run back **2** and **3** scotch the wheels with large scotches.

To Make Ready and Fire.

Officer.	*No.* **1.**
Fire No.....howitzer.	*No.....ready.*
	No.....fire.

1 gives "*Ready*"; **5** presses the tube into the vent with his right thumb, steps clear of the recoil, and holding the lanyard in his left hand stretches it taut, keeping his hand level with the vent facing the front, fore arm across the body.

If the numbers are under cover, **2**, **3** and **4** take an oblique pace outwards and face the muzzle; if not under cover, they take up this position on laying down their handspikes.

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* If a holdfast can be arranged in rear of the howitzer, running back can be more simply and quickly effected with a tackle and two selvagees.

At "*Fire*" 5 slews his body to the left and thus fires the howitzer: he then replaces the vent server, and goes under cover.

Directly the howitzer is fired 2 and 3 scotch up the wheels, 4 steps in and brings the howitzer into the proper position for loading, 2 supplies himself with the sponge, and sponges out the howitzer as soon as the vent server is in the vent; his position is similar to that for ramming home. He holds the sponge with the left hand back down, right hand back up, brings it in line with the axis of the howitzer, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half-turns, pressing it against the bottom of the bore, withdraws the sponge hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle he jerks it out; his hands should then be in the position they were in when he introduced the sponge into the bore. He then replaces the sponge.

If the order to load has been given, the numbers proceed as previously detailed.

If no order has been given, 2 goes under cover as soon as he has replaced the sponge.

1 does not give "*Load*" until 2 has finished sponging.

Drill for Howitzer on Bed.

The drill is the same as for howitzers on travelling carriages with the following exceptions:—

The recoil is checked by means of an iron plate compressor. 1 sets the adjusting lever, with a view to obtaining as much recoil as possible and thus taking the strain off the pivot bolt. He must take care that the directing bar is central so that the compression on each side is equal when the compressor handle is put down.

5 attends to the compressor lever. He throws it up after recoil, and puts it down below the catch as soon as the howitzer is run up and before it is laid. It is liable to throw the howitzer out of line if put down after the howitzer is laid.

To Run Up.—4 hooks a drag rope to the eye bolt in the breast transom. It is manned by the whole detachment. It will be found advantageous to use a tackle instead of a drag-rope when possible.

To Load.—The howitzers are loaded in the firing position.

To Traverse.—2 and 3 are supplied with iron shod lever instead of handspikes. They apply them under the horns of the directing bar.

To Lay.—The howitzer being mounted in the rear of a high parapet, the object fired at cannot be seen over the sights. One of the methods of reverse laying described in Siege Artillery Drill must therefore be adopted.

Howitzers on beds are not to be fired at less than 20° elevation on account of the strain on the pivot. Extreme elevation, 40°.

Auxiliary Marks.

Advantage may be taken of the varied scope of crossbar sights to obtain an auxiliary mark for use in laying the howitzer. Some conspicuous object (such as a steeple) may be chosen, and after the howitzer is laid for direction, by shifting the sliding leaves and

raising or lowering the tangent sight, a line through the sights to the object is obtained. The graduations that the sliding leaves are at, and the elevation on the tangent sight, must be carefully noted. The howitzer then being run up to the same place each time, can be laid as before, every round.

Use of Crossbar Sights.

As a rule these sights will be used for laying for direction only elevation being given by means of the clinometer.

For Forward Laying.

See that the notch on the sliding leaf of the tangent sight and the point of the sliding leaf of the foresight are uppermost, and set both sliding leaves at the fourth graduation, put on the deflection ordered by sliding the crossbar of the tangent sight to the right for right deflection, to the left for left deflection, and lay the howitzer on the target or banderol by moving the trail as required.

For Reverse Laying.

See that the point on the sliding leaf of the tangent sight, and the notch on the sliding leaf of the foresight, are uppermost; set both sliding leaves at the fourth graduation, and proceed as described above.

To Pick Up an Auxiliary Mark.

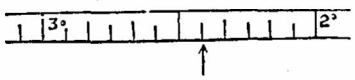
The line of fire is obtained by any of the recognised methods, and a banderol placed in the line at a convenient distance (40 to 50 yards if possible) in rear of the howitzer. The howitzer loaded and run up is laid without deflection, and with the sliding leaves of fore and hind sights clamped at similar graduations, back on the banderol, and consequently in the line of fire. An auxiliary mark in rear is then picked up, by sliding the leaves of the fore and hind sights till they are aligned on the mark, care being taken that the howitzer is not shifted. To align the sights the tangent sight may be raised to any convenient height. The readings at which the sliding leaves are clamped must be carefully noted and also chalked on the piece. Deflection can be given in the ordinary way, the piece being then relaid on the auxiliary mark. Direction should always be given by laying on the auxiliary mark, which, so long as it can be clearly seen to lay on, should be as far back as possible. The description of the auxiliary mark should be noted and chalked on the piece. The howitzer will be laid for elevation by clinometer, after being laid for direction.

For night firing, or where there is much fog, a luminous auxiliary mark is required. For this purpose a bull's-eye lantern is used, contained in a wooden box. In the door of the box is a circular hole, large enough to show the full light of the lantern when used as a distant auxiliary mark, and a brass slide with a cross-cut aperture is fitted behind the door to limit the light when it is suspended close in rear of the emplacement.

INSTRUCTIONS FOR USING THE CLINOMETER.

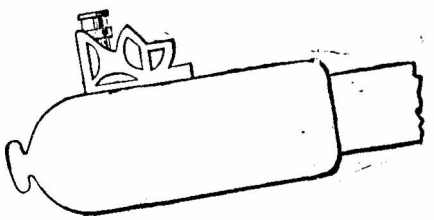
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into twelve parts; each small division, therefore, represents an angle of 5 minutes.

The scale is read from right to left, thus—



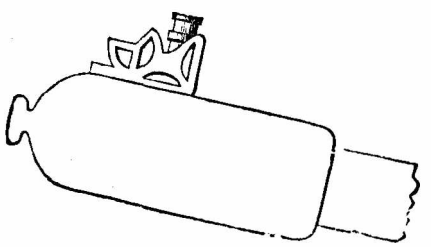
the reading opposite the arrow would indicate an angle of 2° 25′.

To lay the howitzer at any angle up to 45°.—Unscrew the drum, until the ⅄ points to the elevation required; place the clinometer, thus—



on the plane surface cut on the breech, and elevate the piece until the bubble of the spirit level is in the centre of the tube.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



POINTS TO BE ATTENDED TO IN USING THE CLINOMETER.

The base of the clinometer and the plane surface on which it is to rest should be clean and free from grit, dirt, or rust.

The clinometer should be set by turning the drum to the left, past the elevation ordered, and finishing by a turn or two to the right to the exact elevation ordered.

The clinometer should be placed on the same part of the plane surface, and the layer should stand in the same place when laying for each round.

CARRIAGE AND LIMBER FOR 8-INCH HOWITZER, 46 CWT.

LIMBER.

ON FOOTBOARD.

Drag ropes. Swingletree.
Lifting jack, Clerk's.
Spanner, hydraulic buffer, No. 1.

Drag washer, 1st class, Maul } under.
Bill hook, Drag washer, 2nd class } under.

Spade, Water brush } under.

STORE LIMBER BOX.

Arc, elevating, on outside of Box.

Spade, under.

Grease tin, 3 lb., under.
Pickaxe, Water bucket } under.

3 Handspikes, on top.
Wadhook, Sponge, Brush piasaba.

CARRIAGE.

Spanner (McMahon). Pincers. Rammer.
2 Handspikes, on top. Drag shoe and chain.

1 Pricker in case.
Water brush.

Hammer. Arc, elevating.

Shell bearer.
Tampeon in howitzer.

DETAILED CONTENTS OF THE LIMBER BOX.

BOX LID.

1 Sight, fore.

1 Clipper, portfire.
1 Extractor, fuze.
1 Punch, vent.
1 Pincers, shrapnel, primer.
1 Spike, spring.

1 Clamp, tangent sight "B."
1 Sight, tangent.

LIMBER BOX.

1 Can, oil, lubricating.

2 Spikes, common.
1 Knife, clasp.

1 Wrench, pivot, No. 4.
*1 Plate, elevating, with screws.
1 Line, Hambro.
1 lb. Slowmatch.
1 lb. Marline.
1 lb. Twine, packing.

1 Clinometer, in case.

1 Pocket, tube, and strap.

1 Driver, set.

4 Cloths, sponge.

25 Friction tubes.

3 Lanyards.
1 Plummet.
3 Washers, leather, plug, filling, buffer, in tin box.
2 Rings, packing, hydraulic buffer.

1 Stick, portfire.
1 Key, fuze, universal.
1 Key, plug G.S.
1 Line, and 1 Reel, line, carpenter's.
4 oz. of chalk, white.
1 Spanner, buffer, No. 6.
2 Portfires.
1 Driver, screw, shrapnel, large.

1 Cylinder, with 6 bits.
1 Plug vent.
1 Hook, borer.
2 Vent servers and lanyards.
2 Pins, linch (one 1st and one 2nd class).
20 Ties, linch pin.
1 Key, powder case.

* Placed in box, when not on gun, to prevent injury.

ORDNANCE, R.M.L. 8 INCH, HOWITZER, 46 CWT., MARK I.

STEEL & WROUGHT IRON.

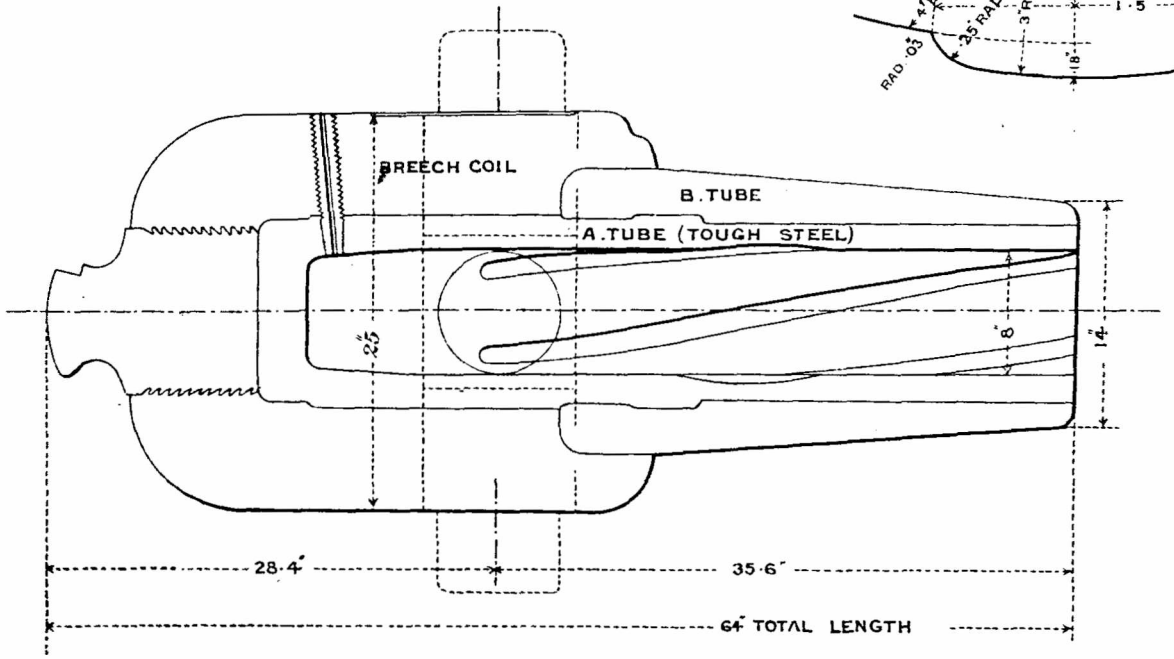
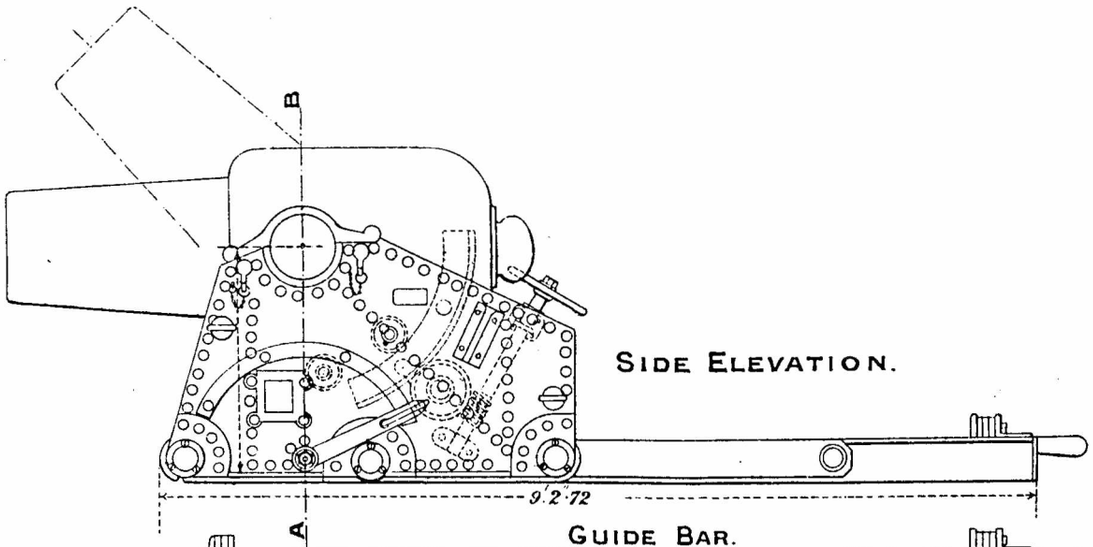


Plate I.

515·5·1900

E. Waller & Graham's Lith. London.

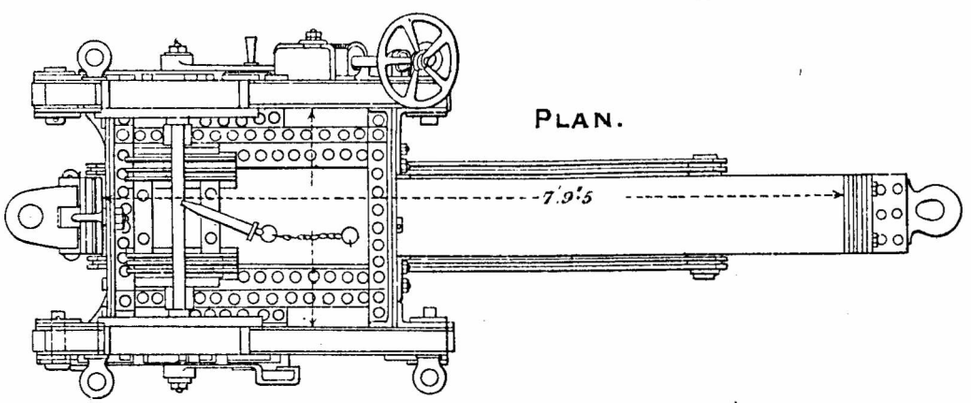
BED, HOWITZER, R. M. L, 8 INCH. 46 CWT.



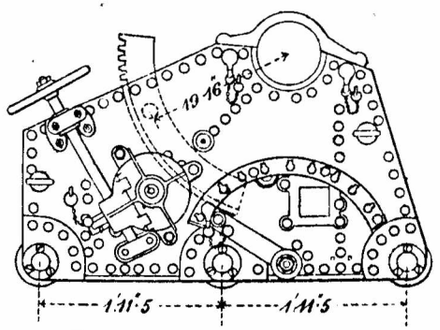
SIDE ELEVATION.

GUIDE BAR.
ELEVATION.

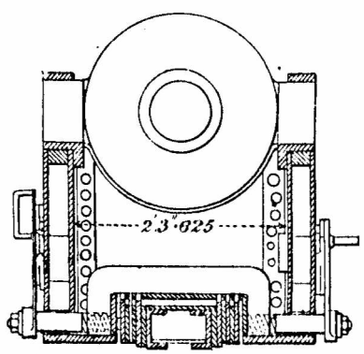
PLAN



PLAN.



SIDE ELEVATION. (*RIGHT SIDE.*)



SECTIONAL ELEVATION
THROUGH A. B.

SCALE.

Inches 12 9 6 3 0 1 2 3 4 5 6 7 *Feet*

E. Weller & Graham's Ltd Litho London.

Carriage, Siege, R.M.L. Howitzer, 8 In. 46 Cwt. Mark I.

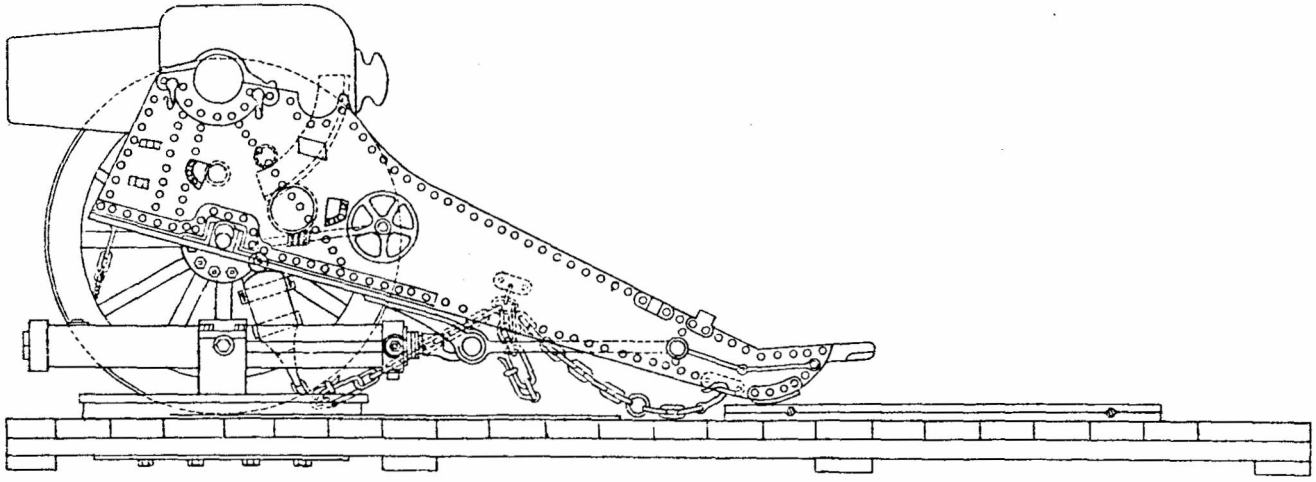
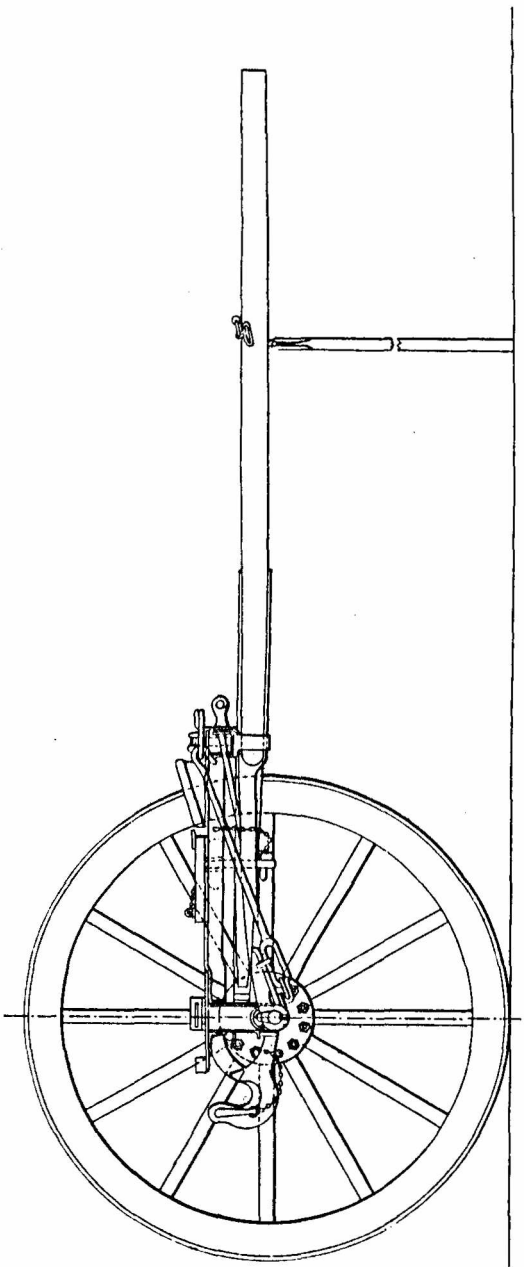


Plate III.

S.T.O.-5-1900.

E. Wallis & Grahams Ltd Lithg. London.

LIMBER, SIEGE, R.M.L. MARK I.



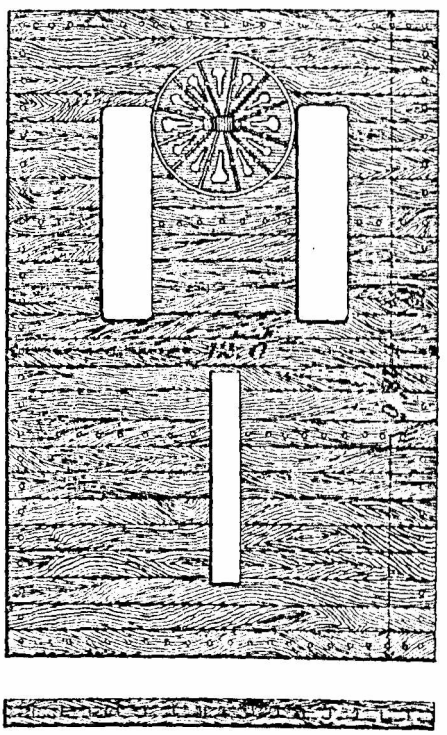
570 5 1900

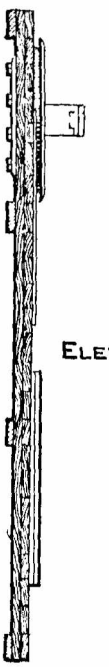
E. Weller & Grahams Ltd Litho London.

PLATFORM, SIEGE, DOUBLE DECKED, MARK I.

With plug, pivot, N°. 17.

TOP PLAN.





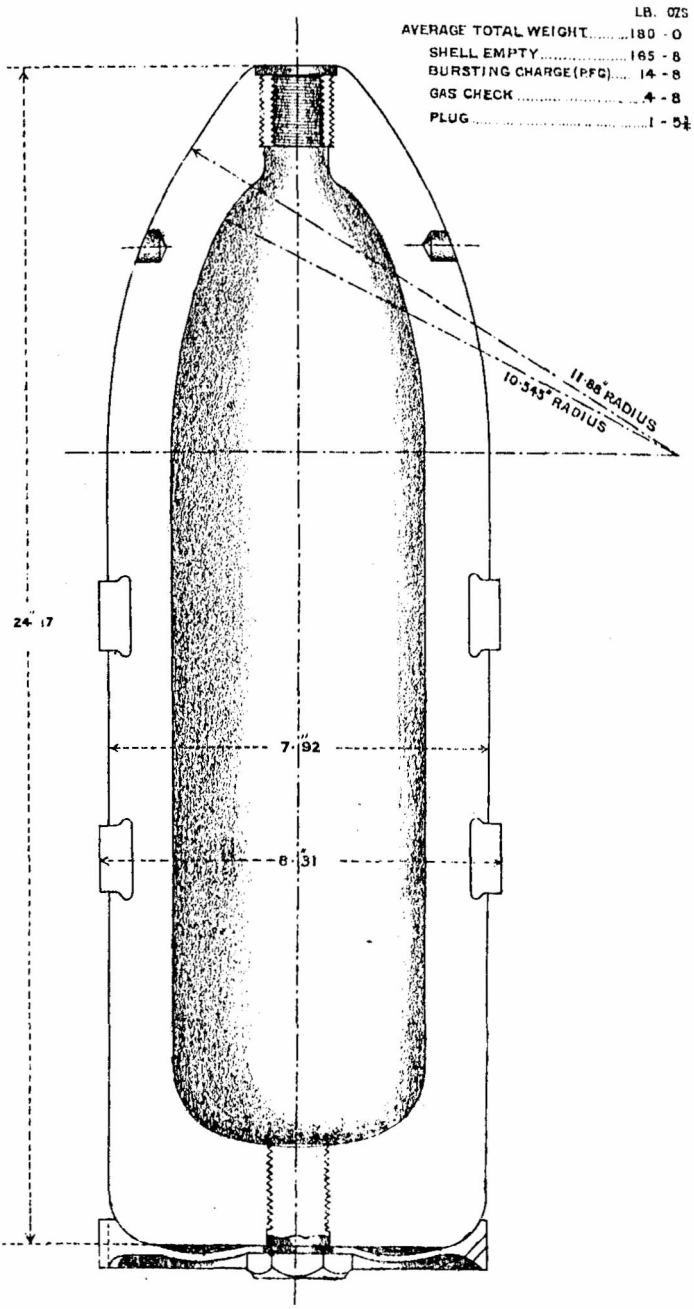
ELEVATION.

END VIEW.

570 5 1900.

E. Weller & Co. Lambeth 1st Litho London.

SHELL, R.M.L. HOWITZER, COMMON. 8 INCH, 46 CWT.
MARK II.

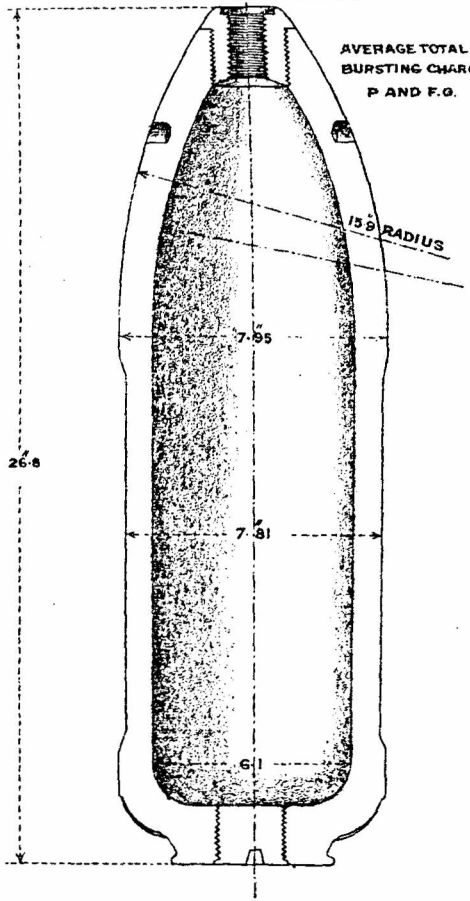


E. Weller & Graham, 1st Litho. London.

SHELL, R.M.L. COMMON, 8 INCH HOWITZER, STUDLESS, CAST STEEL, MARK III.

	LB. OZ.
AVERAGE TOTAL WEIGHT	180-0
BURSTING CHARGE	25-15

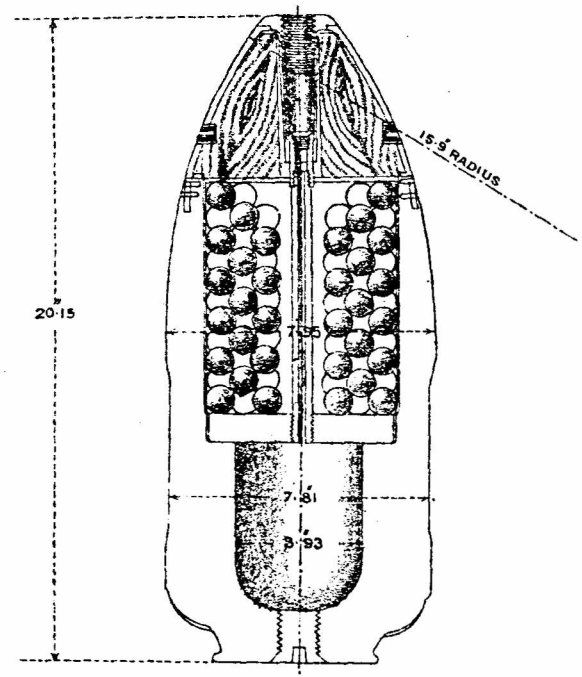
P AND F.G.



SHELL, R.M.L. SHRAPNEL, 8 INCH. HOWITZER. MARK I.

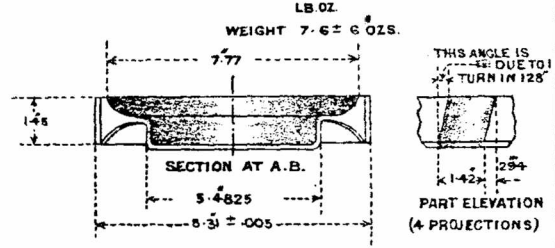
CAST STEEL.

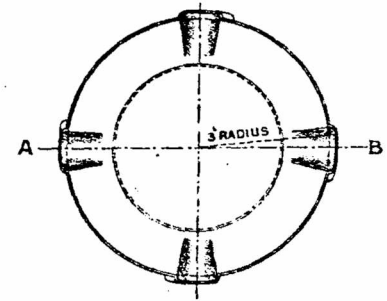
	LB. OZ.
AVERAGE TOTAL WEIGHT	180 . 0
BURSTING CHARGE	2 . 0
540 BULLETS (14 PER LB.)	38 . 0



GAS CHECK, R. M. L. 8 INCH HOWITZER, 46 CWT. AUTOMATIC, MARK I.

COPPER.





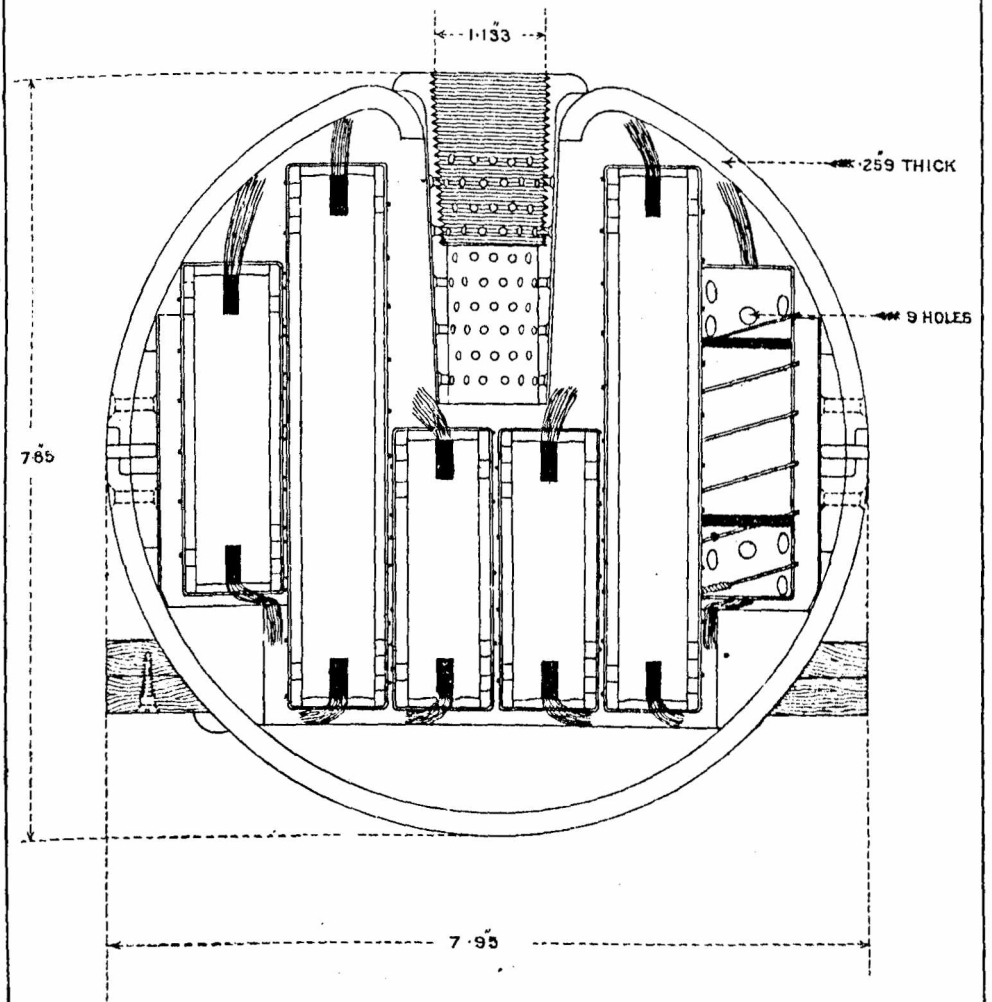
INVERTED PLAN.

Plate VII.

SHELL, R.M.L., FILLED, STAR, 8 INCH, MARK IV.

SPHERICAL.

SCALE $\frac{1}{2}$.



570·5·1900.

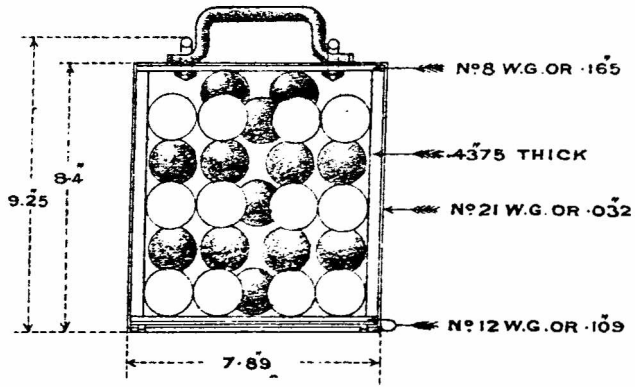
E. W. Cotter & Grahams Ltd Litho. London.

S.T.O. 5-1900.

SHOT, R.M.L. CASE, IRON, 8 INCH. MARK III.

SCALE 1/6.

	LB. · OZS.
AVERAGE TOTAL WEIGHT	74 · 0
CASE	28 · 1½
CLAY AND SAND	9 · 8
SAND SHOT (8 OZ.)	36 · 7½



E. Weller & Graham's Lith. London.

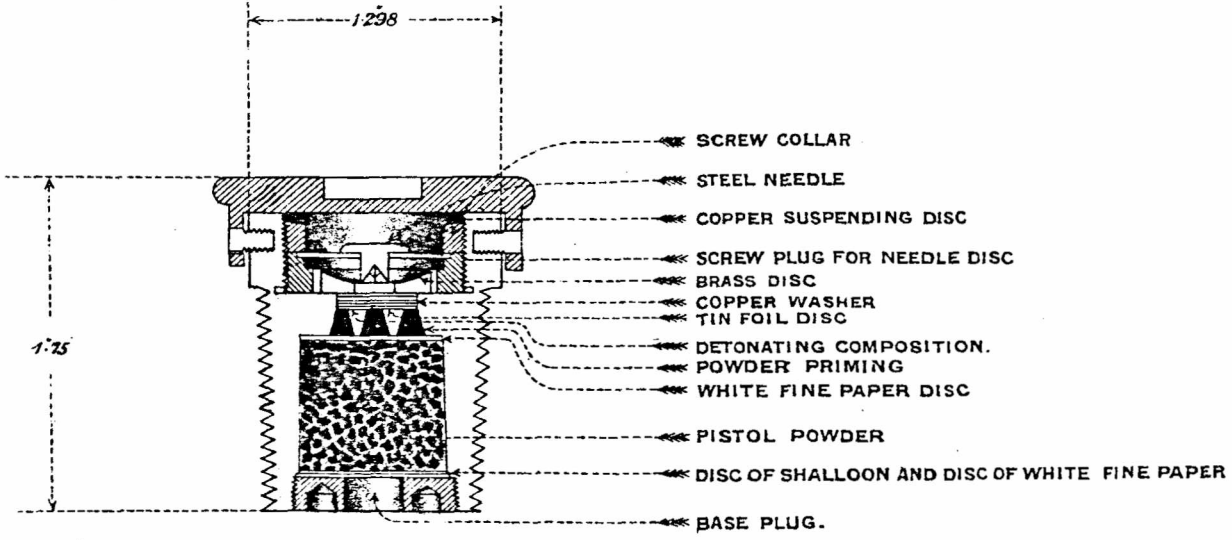
Plate IX.

570.5.1900

FUZE, PERCUSSION, DIRECT ACTION, Nº. 1, MARK II.

METAL; 5 IN A TIN CYLINDER.

FULL SIZE.



E. Walker & Graham's Lith. London.

Plate X.

FUZE, PERCUSSION, DIRECT ACTION, DELAY, No. 10. MARK III.

METAL: I IN A TIN CYLINDER.

FULL SIZE.

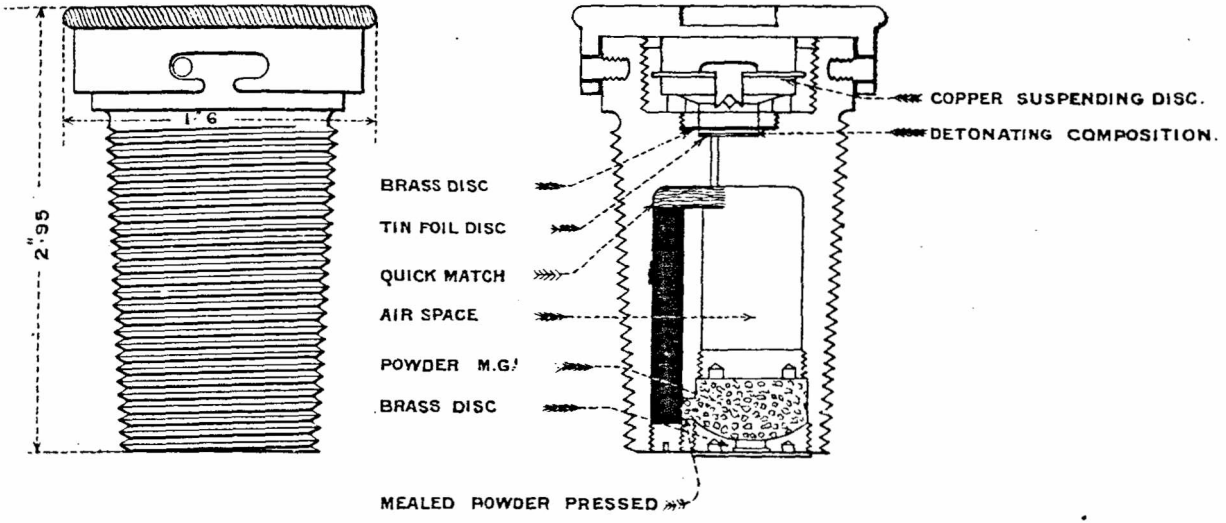
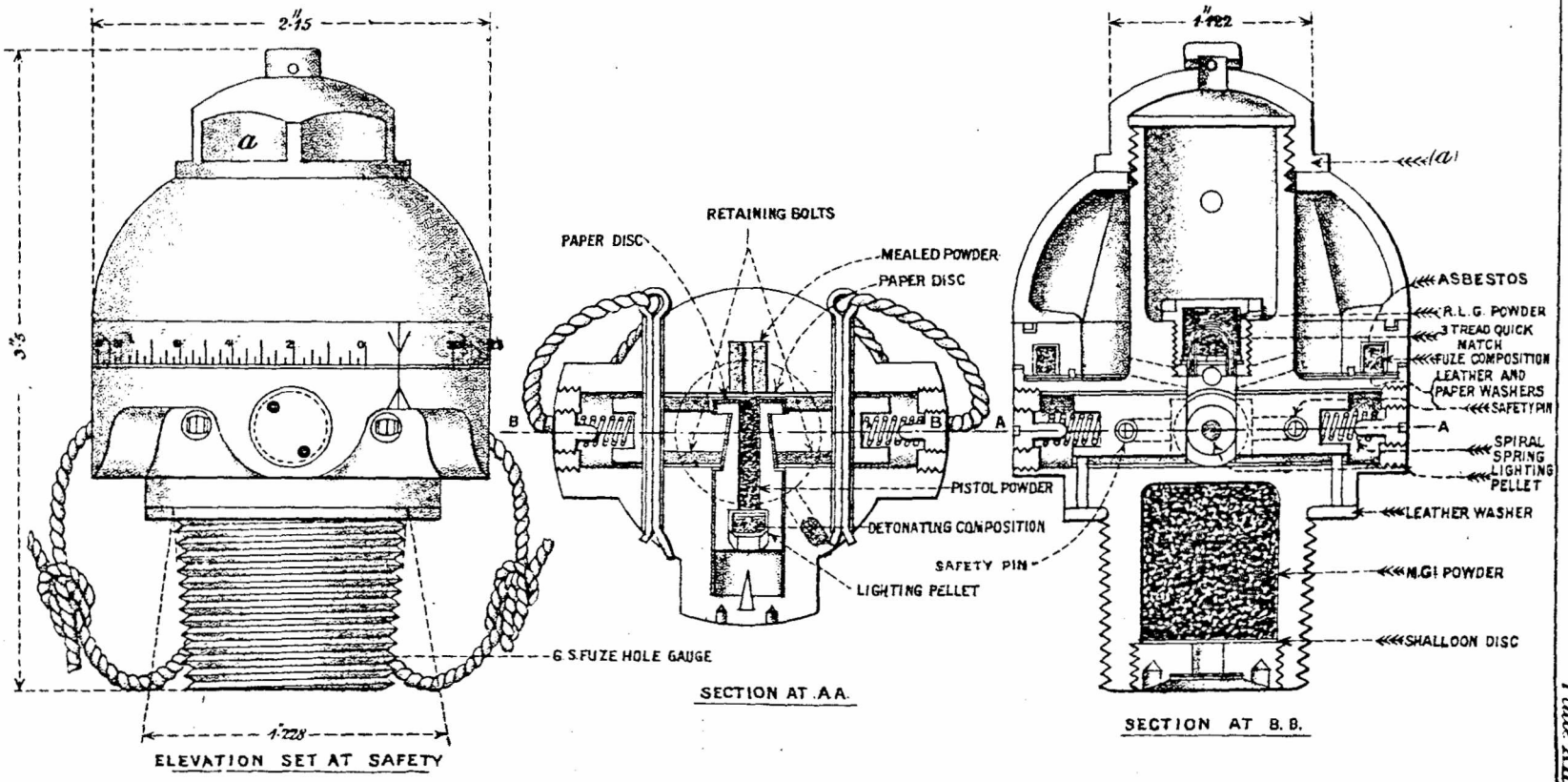


Plate XI.

FUZE, TIME, SENSITIVE, MIDDLE, No 24. MARK I.

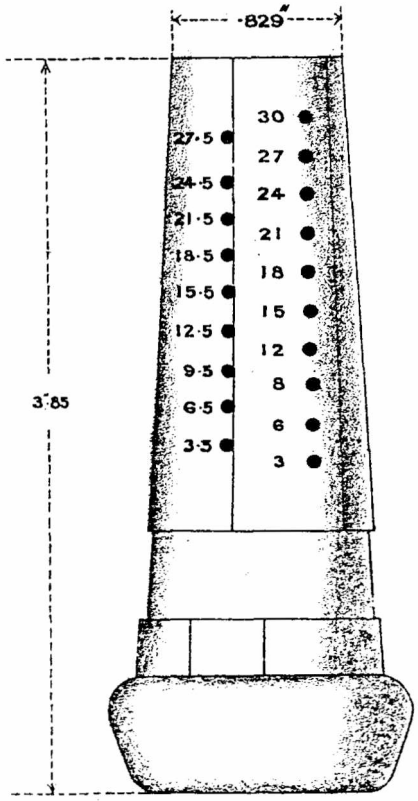
FULL SIZE.

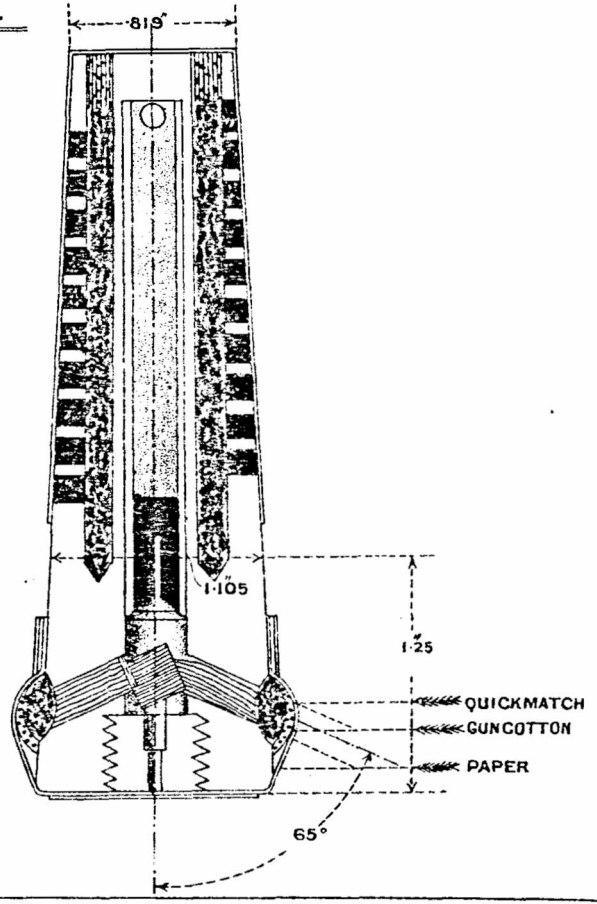


E. Weller & Grahams Lith. London.

FUZE, TIME, 15 SECONDS, M. L., SPECIAL PRIMING, No. 42. MARK I.

FULL SIZE.

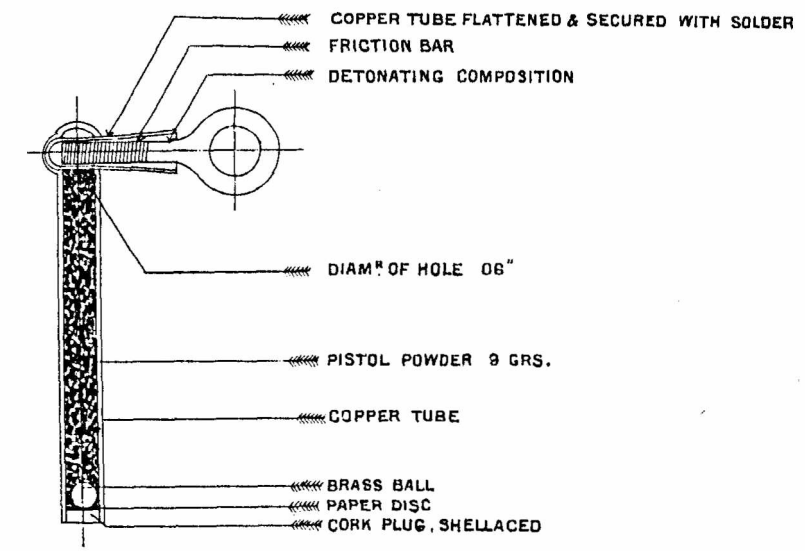




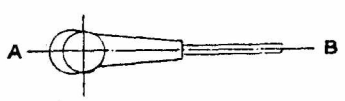
570. 5.1900.

Plate XIII.

TUBE, FRICTION, COPPER, SOLID DRAWN, WITH BALL.
MARK II.
Full Size.



SECTION AT A.B.



PLAN.

E. Weller & Grahams Ltd Litho London.

ALTERATIONS.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

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